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July 1947

TECHNOLOGY REVIEW

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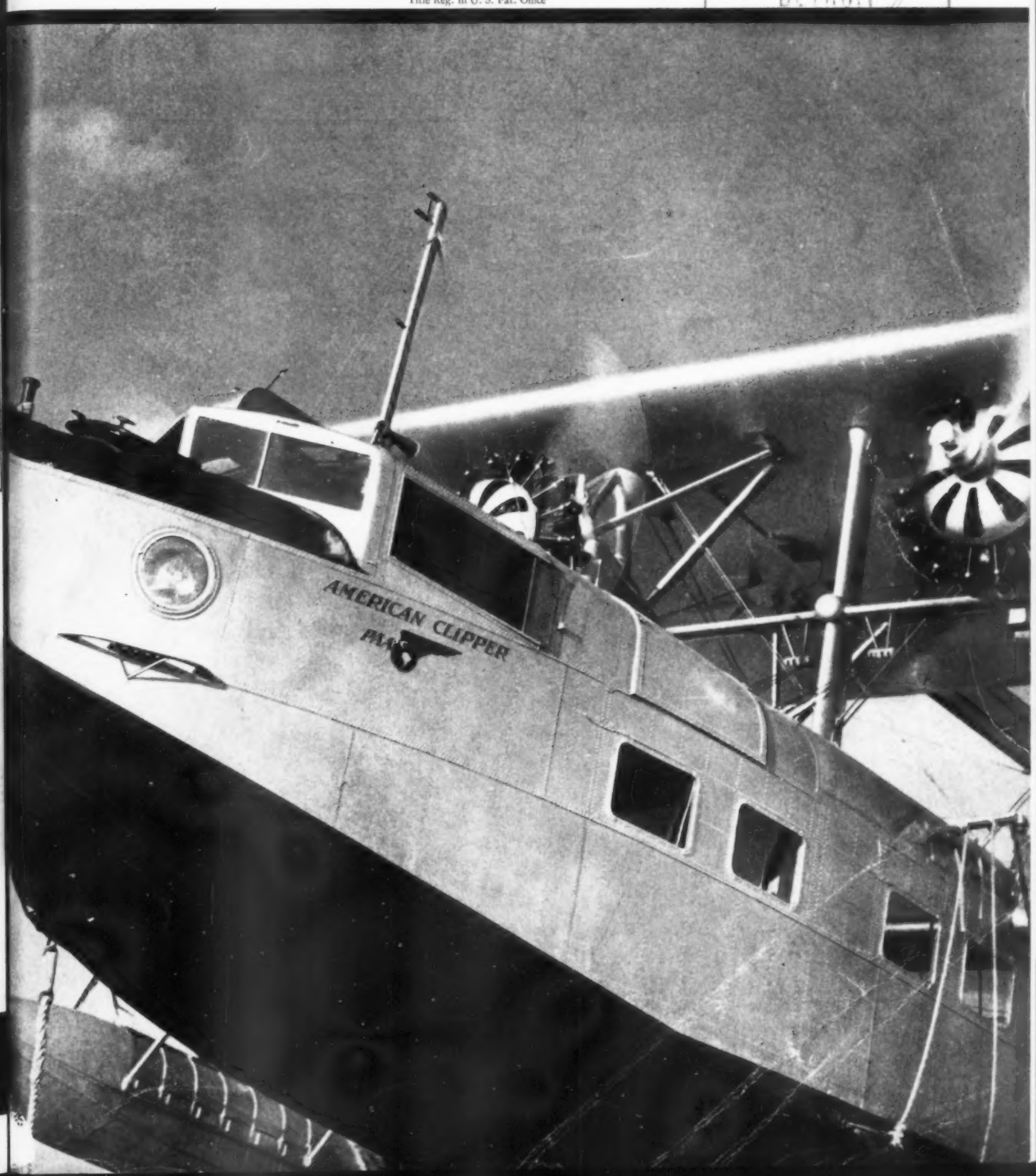

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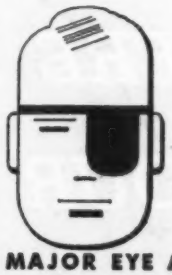

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AVERAGE COST OF ONE PAIR SAFETY GOGGLES

$326.50 . . . . . SAVED

BY PREVENTING 1 EYE ACCIDENT

Above is the simple arithmetic of what one major eye accident involves—and the relatively *infinitesimal* cost of the means to prevent it. Some authorities put the direct cost of major eye accidents even higher—at $351 and estimate the hidden or indirect expense as *4 times as much* in terms of idle machines, lowered production, cost of time lost by injured employee, foremen and others and additional factors. Why risk even one eye accident that can add to today's burden of pyramided costs? 98% of eye accidents can be prevented by the use of safety goggles, according to the Society for the Prevention of Blindness. Your AO Safety Representative has complete facts and figures which prove that adequate eye protection can lower *your* costs.

American Optical COMPANY
Safety Division

SOUTHBRIDGE, MASSACHUSETTS
BRANCHES IN PRINCIPAL INDUSTRIAL CITIES

THE TECHNOLOGY REVIEW, July, 1947. Newsstand Edition. Vol. XLIX, No. 9. Published monthly from November to July inclusive at 10 Ferry Street, Concord, N. H. Publication date: twenty-seventh of the month preceding date of issue. Annual subscription $3.50; Canadian and Foreign subscription $4.00. Entered as second-class matter at the Post Office at Concord, N. H., under the Act of March 3, 1879.

HERE IS YOUR INSURANCE

AGAINST THE COST OF CARELESSNESS!

A single hurried or careless job with an *ordinary* heavy marine rope can throw a distortion or back-kink into it that seriously shortens its life, weakens its strength, *and adds to your operating costs.*

Slevelay's marvelous combination of *strength, flexibility, easy-handling* and resistance to careless use comes from its exclusive, concentric sheaths of unspun fibers. These "sleeves" prevent the interchange of the rope's inner and outer yarns, which is the actual cause of distortion. The larger the rope, the greater the risk of back-kink in ordinary rope through inexperienced handling—and *the greater* the *value* of *Slevelay* in *avoiding* that common form of rope destruction.

Slevelay, made *exclusively by Plymouth,* is available through your local Plymouth supplier, in 5½ inch circumference and larger sizes.

PLYMOUTH CORDAGE COMPANY
Plymouth, Massachusetts.

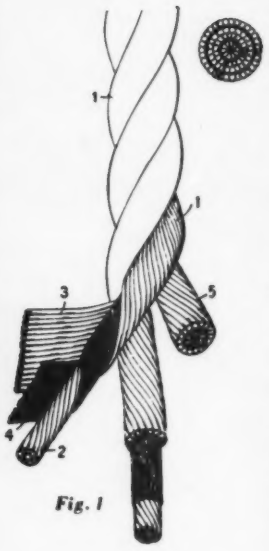


Fig. 1

Why Slevelay Has No Back-Kink

The diagram above shows why and how Slevelay's unique construction gives this Plymouth Marine rope its exclusive combination of *strength, flexibility* and *freedom from back-kink.* The following key explains the outstanding features of Slevelay construction:

1.

(above) outer surface of strand, (below) same strand, showing course of spun yarns.

2.

Center yarns, which in "Slevelay" are left-twisted, being opposite to the twist imparted to center yarns in rope of usual construction.

3.

Cover yarns.

4.

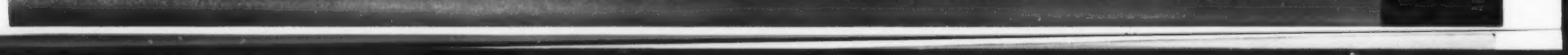
The "sleeve"—a thin, broad sheet of barrier fiber, partitioning center yarns from cover yarns.

5.

End view of strand.

PLYMOUTH
Cordage Products

THE ROPE YOU CAN TRUST BECAUSE IT IS ENGINEERED FOR YOUR JOB



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THE same characteristics of hardness and toughness which make Alundum abrasive so useful in grinding wheels, also give it valuable properties as a wear-resistant and non-slip flooring material.

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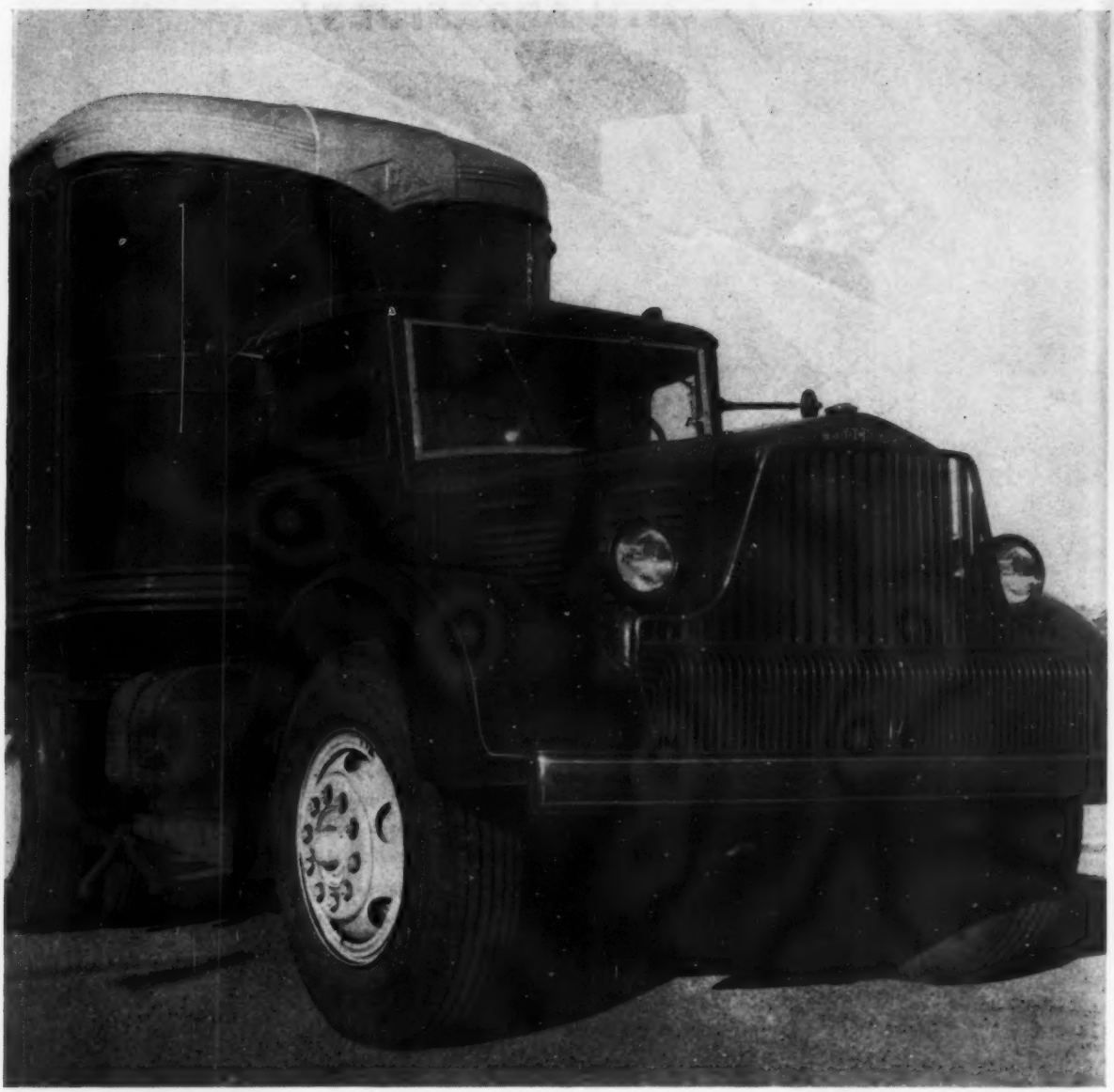

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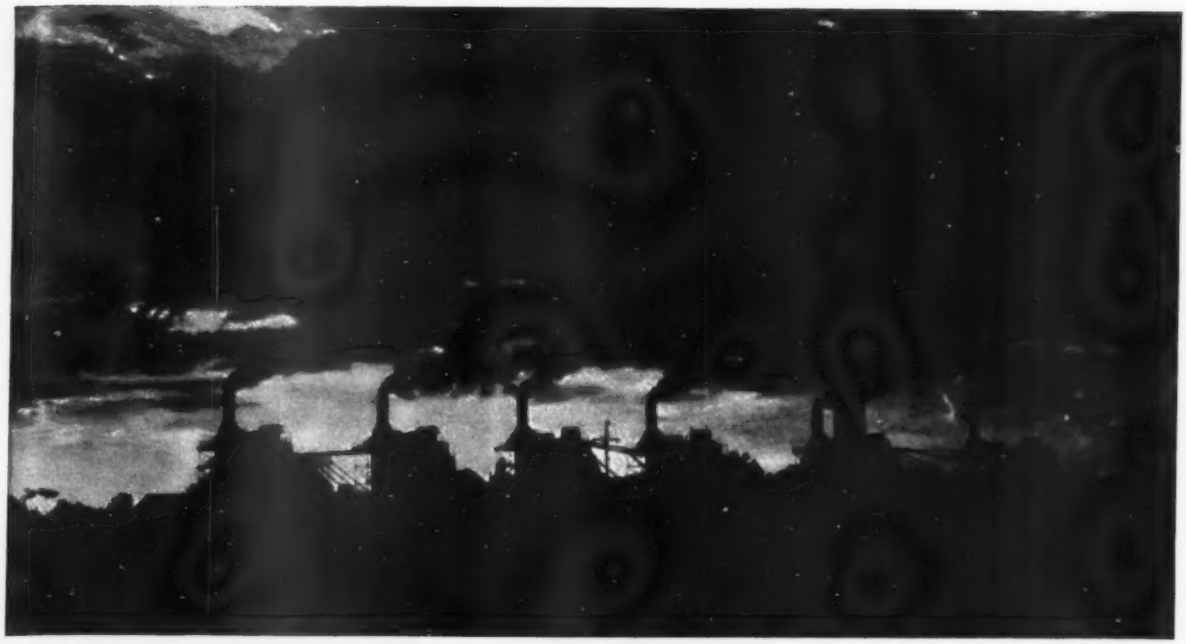

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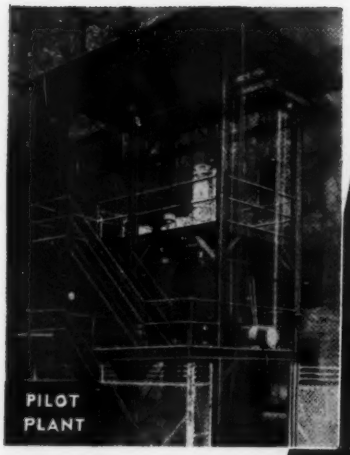

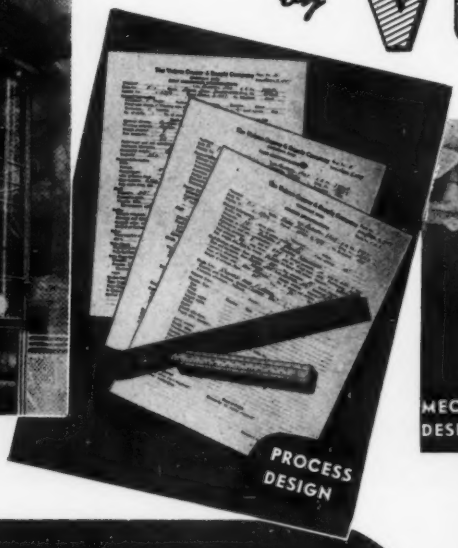

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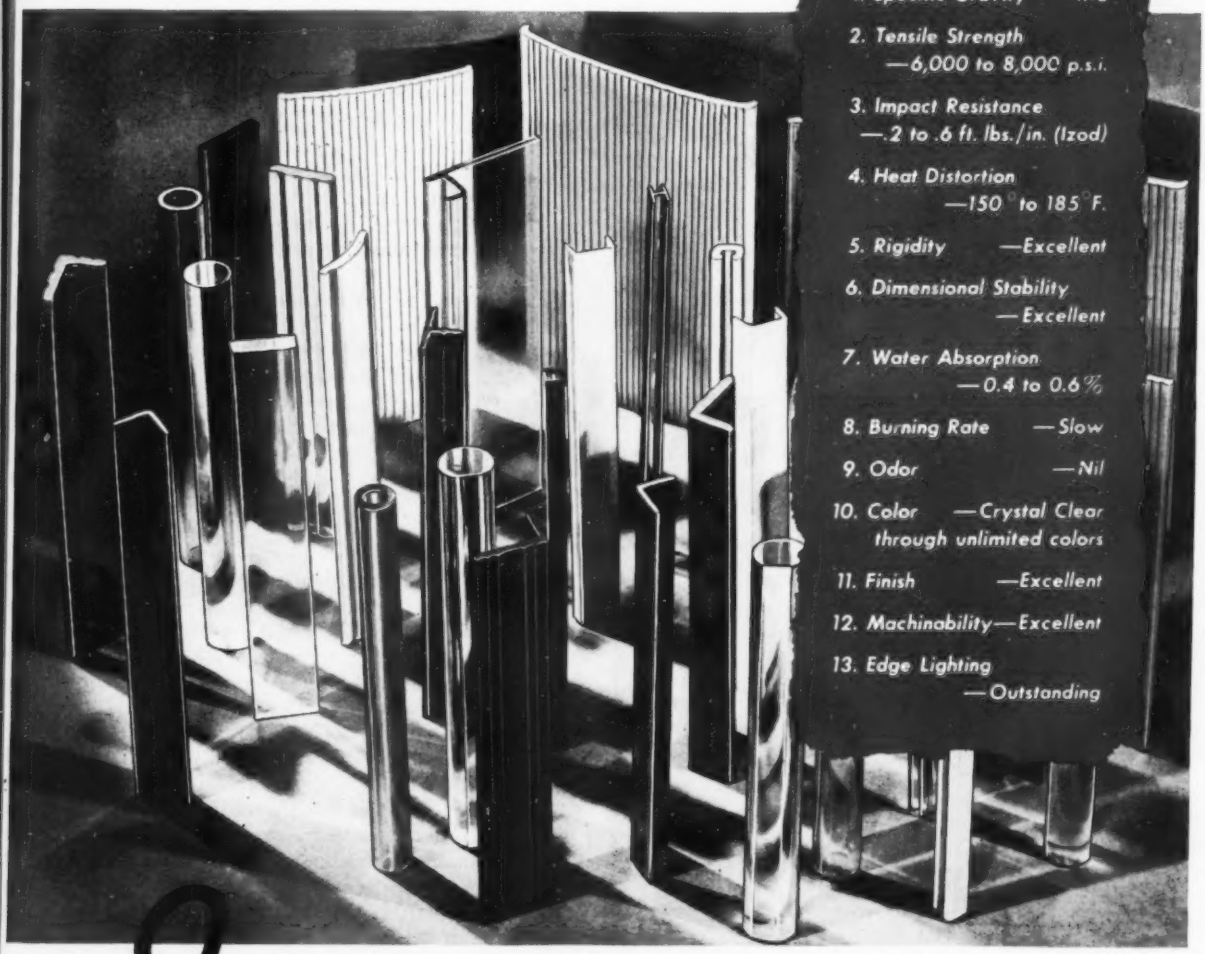

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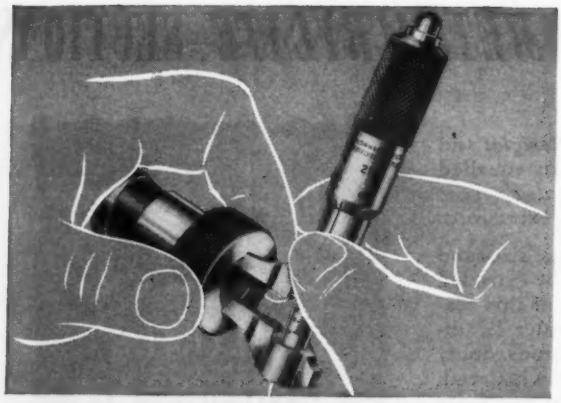
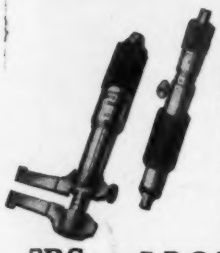


THE MACHINISTS' CHOICE



● From the early days of American Industry, Machinists have used—and preferred—Brown & Sharpe Precision Tools. Inside micrometers Nos. 252 and 270, shown here, are important items in this famous line. Also included are rules, combination squares, bevel protractors, straight edges, vernier tools, dial indicators and other tools. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

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BUSY MEN

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THE TABULAR VIEW

A vigorous program of aircraft research to maintain national security and further develop commercial enterprise was advocated in the Alumni Day symposium address (page 523) of GENERAL GEORGE C. KENNEY, '11, Commander, Strategic Air Forces. General Kenney's address also stimulates thinking as to the types of research most urgently needed at the present time.

Looking forward to the time, not so far in the future, when families may spend the major part of their two weeks' vacation on other continents through air travel, JOHN C. LESLIE, '28, Vice-president of Pan American World Airways, urges (page 525) a strong American commercial air-transport system as a most effective means of cementing international relations.

Unsolved mysteries of the behavior of the gas turbine and the development of this means of motive power for commercial aviation will give way before the onslaught of research already in progress. Such is the belief of ARTHUR E. RAYMOND, '21, Vice-president of the Douglas Aircraft Corporation, as expressed (page 527) in his address "Future of Gas Turbines in Aviation" delivered at the Alumni Day symposium.

Management problems of the Atomic Energy Commission raise as many, and as serious, problems as the purely technical ones of utilizing nuclear forces. CARROLL L. WILSON, '32, General Manager of the Atomic Energy Commission, makes an appeal to all (page 529) not only to learn the significance of atomic energy but to aid the Atomic Energy Commission in its most difficult assignment in developing peacetime uses for nuclear forces.

Needed by tomorrow's leaders is an objective, analytical approach in dealing with future problems, PRESIDENT COMPTON told the graduating class, in exercises at Boston's Symphony Hall. Dr. Compton's address is recorded in full, beginning on page 531; his annual report to Alumni, delivered at the Alumni Banquet, appears on page 537 of this issue of The Review.

In recalling the brief period during which the United Nations has been in existence, the HONORABLE WARREN R. AUSTIN, Chief of the United States Mission to the United Nations, spoke encouraging words to graduates in his commencement address recorded on page 533. But, supplementing the hope for a great future for the United Nations, is the need for the United States to be willing and able to stand behind its commitments.

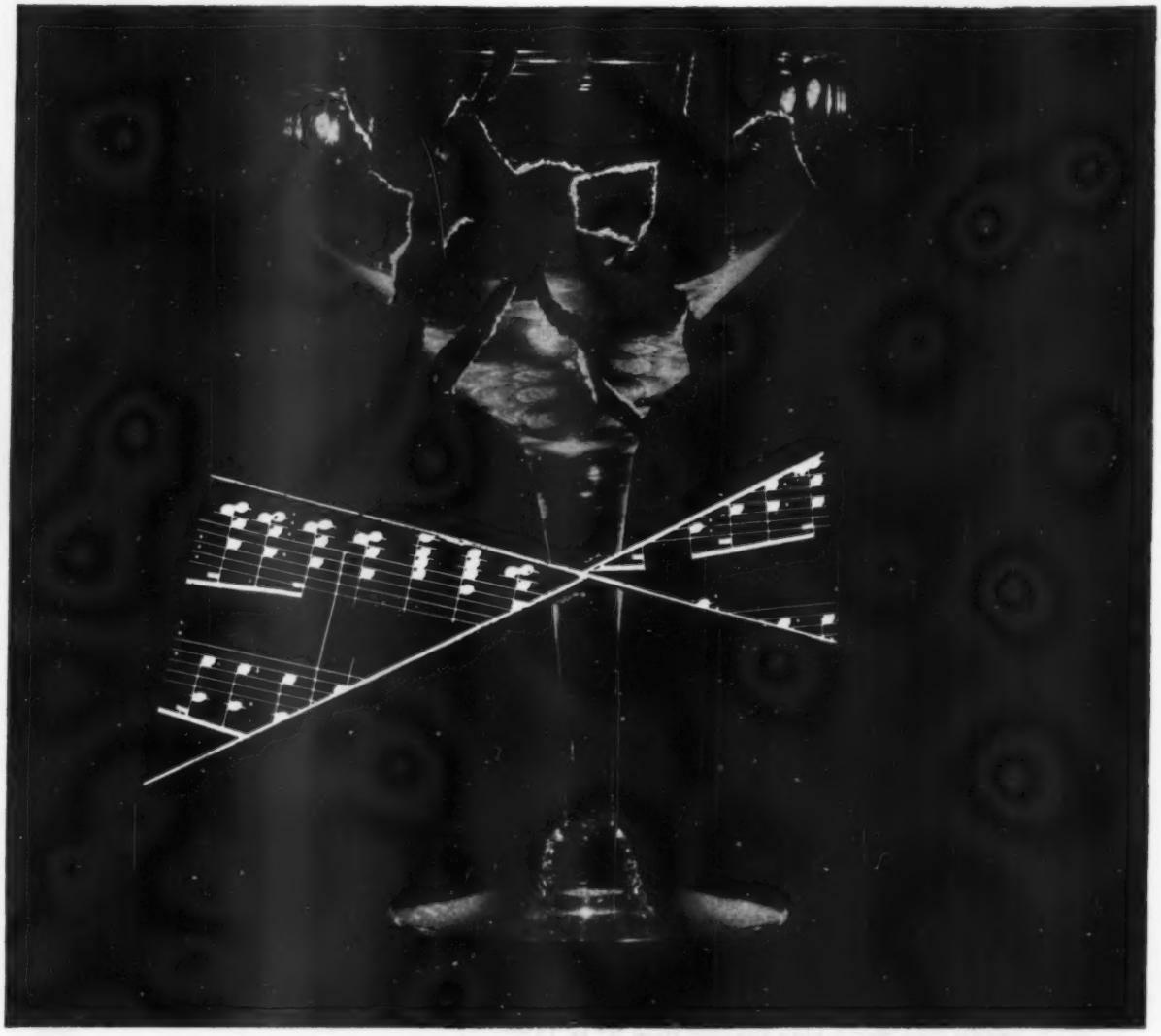
The Review is not published during the summer months following July. This issue, therefore, concludes Volume 49. Number 1 of Volume 50 will be published on October 27 and dated November. Readers who bind their copies are reminded that if they possess nine issues of Volume 49, their files are complete. An index to the volume will be ready on September 30 and will be supplied post free upon request.

A FEW NOTES TO REMEMBER

It is possible to shatter a wine glass with a sustained musical note because the glass is too brittle to distribute the peak stresses that are set up by resonance.

For the same reason, failure can result in a brittle steel, with far more serious consequences than a mere broken glass.

One way to increase safety factor and to obtain many other advantages, is to specify temper-brittle-free molybdenum steels. These *modern* steels, which also provide good hardenability, good strength-weight ratio, and economy, are permitting many users to simplify — and save. Write for practical data.



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No. 33 has a capacity of 3", the No. 34 of 4" and the No. 35 of 5½" through the collet chuck.

Parallel sizes of manually operated hydralectric cutting-off machines are adapted for low cost production in smaller lots and greater variety of work.

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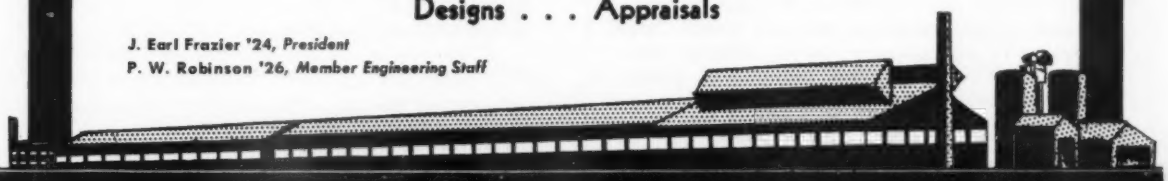
Complete Glass Manufacturing Plants
Modern Ventilated Steel Factory Buildings
Designs . . . Appraisals

J. Earl Frazier '24, *President*
P. W. Robinson '26, *Member Engineering Staff*



SIMPLEX EQUIPMENT

Complete Glass Manufacturing Plants
Modern Ventilated Steel Factory Buildings
Designs . . . Appraisals

HEVI DUTY

Hevi Duty Electric Co.

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With the acquisition of the Surges Electric Company of Milwaukee, Hevi Duty can now offer quality dry type air cooled transformers with or without tap changing switches as well as special transformers for special requirements. An accelerated program of modernization will present opportunities for increased production and good delivery schedules.

Write for Bulletin S-4611

HAROLD E. KOCH '22, *President*

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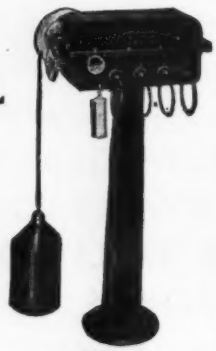

Write for Bulletin 940

The 940 is ideal for complex control of multi-pump installations. Any desired number of starting and stopping positions for each pump. Any sequence of operation — more uniform flow through use of maximum number of pump combinations.

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(*Concluded on page 510*)

THE STORY OF MANGANESE

12th CENTURY BEAUTY

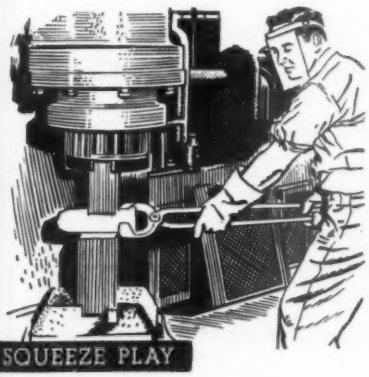
1 Manganese minerals were known in ancient times and were used to produce the rich colors of medieval stained glass windows. However, it was not until 1774 that the metal manganese was isolated. It became important to steelmakers in 1856 when Sir Robert Mushet used it to perfect the bessemer process.

MOVING MOUNTAINS

2 Mountains of manganese ore from such far-off places as Africa, Russia, India, and Brazil are shipped each year to the United States to meet our nation's requirements. In Electromet's furnaces, these ores are reduced to ferromanganese, silicomanganese, and other alloys of high purity.

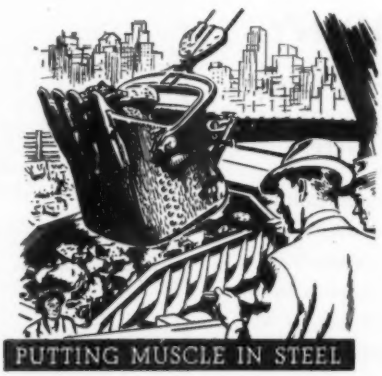
TAMING THE BREW

3 Manganese is the most important alloy used in steelmaking. It has a powerful attraction for oxygen and sulphur — gathering and removing these impurities as a slag during the deoxidizing process. One of the best of all deoxidizers is silicomanganese — a combination alloy of silicon and manganese.



SQUEEZE PLAY

4 By combining with sulphur, manganese removes the principal cause of hot-shortness — thereby giving steel better rolling and forging properties. It imparts great strength and toughness, and that's why all steels—castings, forgings, and rolled products—contain at least small amounts of this metal.



PUTTING MUSCLE IN STEEL

5 Manganese makes steel tough. Steel containing about 13 per cent manganese is "work-hardening," that is, it possesses the property of increasing in hardness as the metal is worked. Steam shovel teeth, crushing machinery, and railroad switch frogs would quickly wear out, were it not for this property.

Aid To Steelmakers

Electromet's staff of experienced and well trained metallurgical engineers are always ready to assist steelmakers with the proper use of ferro-alloys, and help solve other metallurgical problems relating to melting procedures. These men are familiar with the most efficient and up-to-date shop practices. Their specialized knowledge has assisted customers in solving many metallurgical problems. For further information write for our booklet "Electromet Products and Service."

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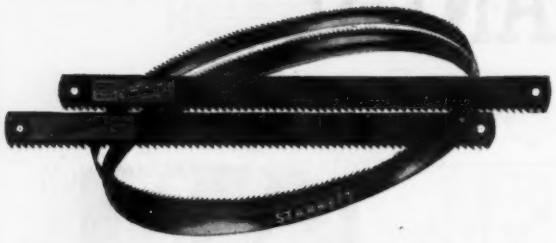

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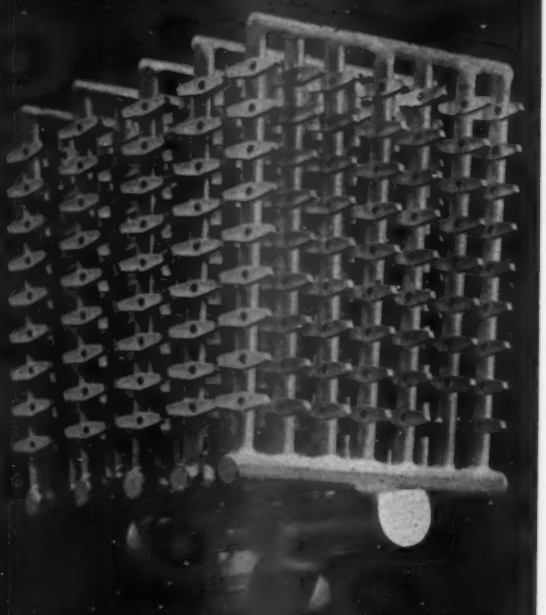

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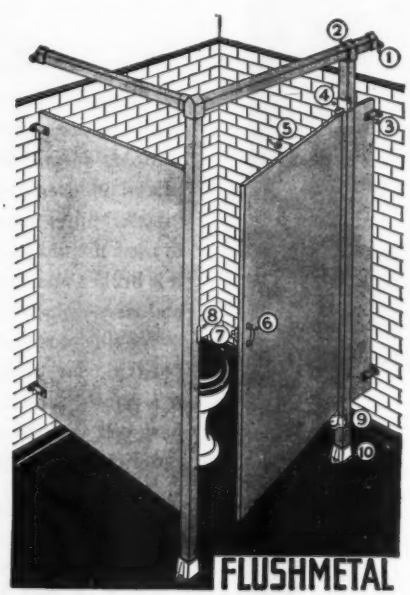

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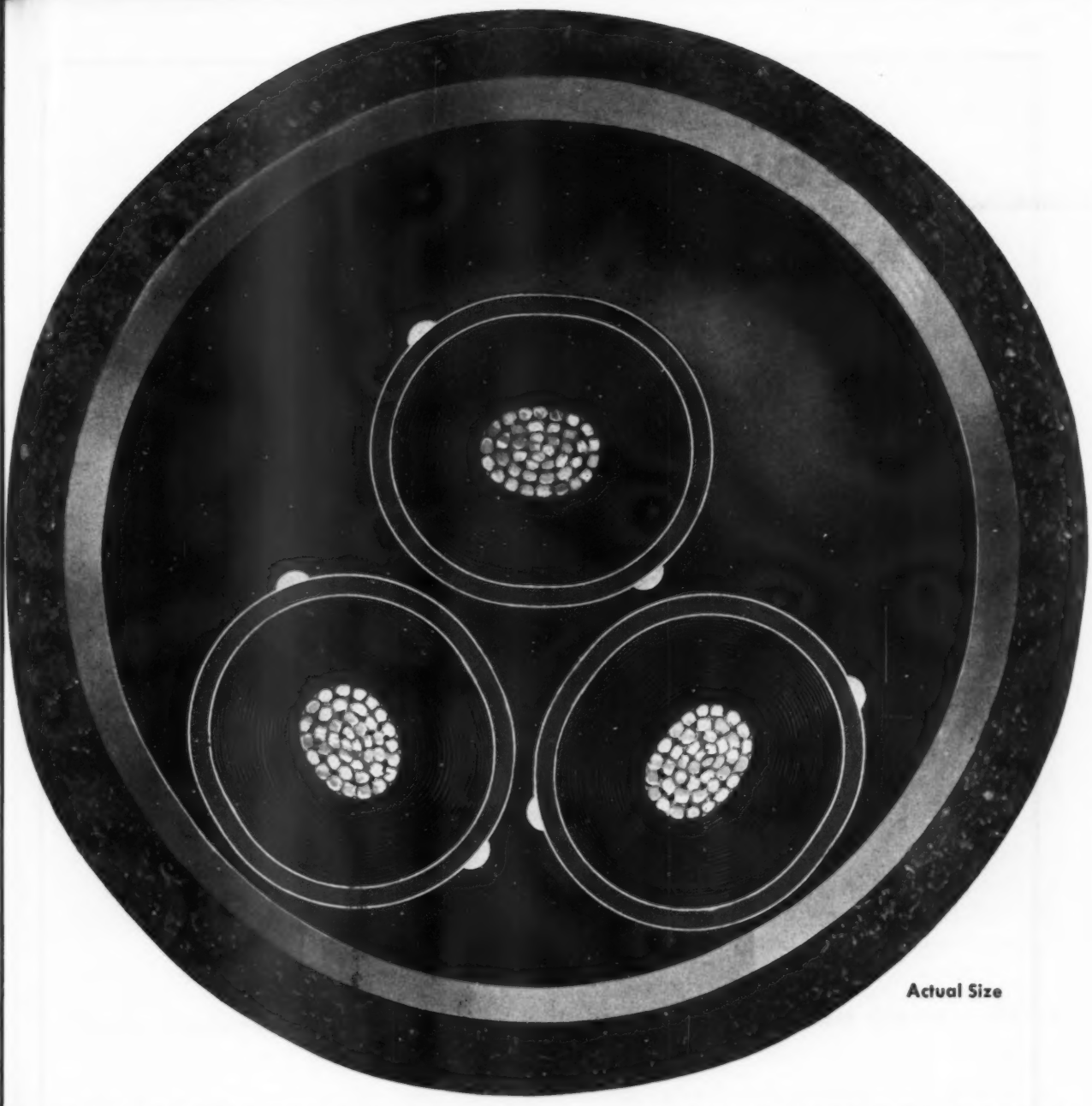

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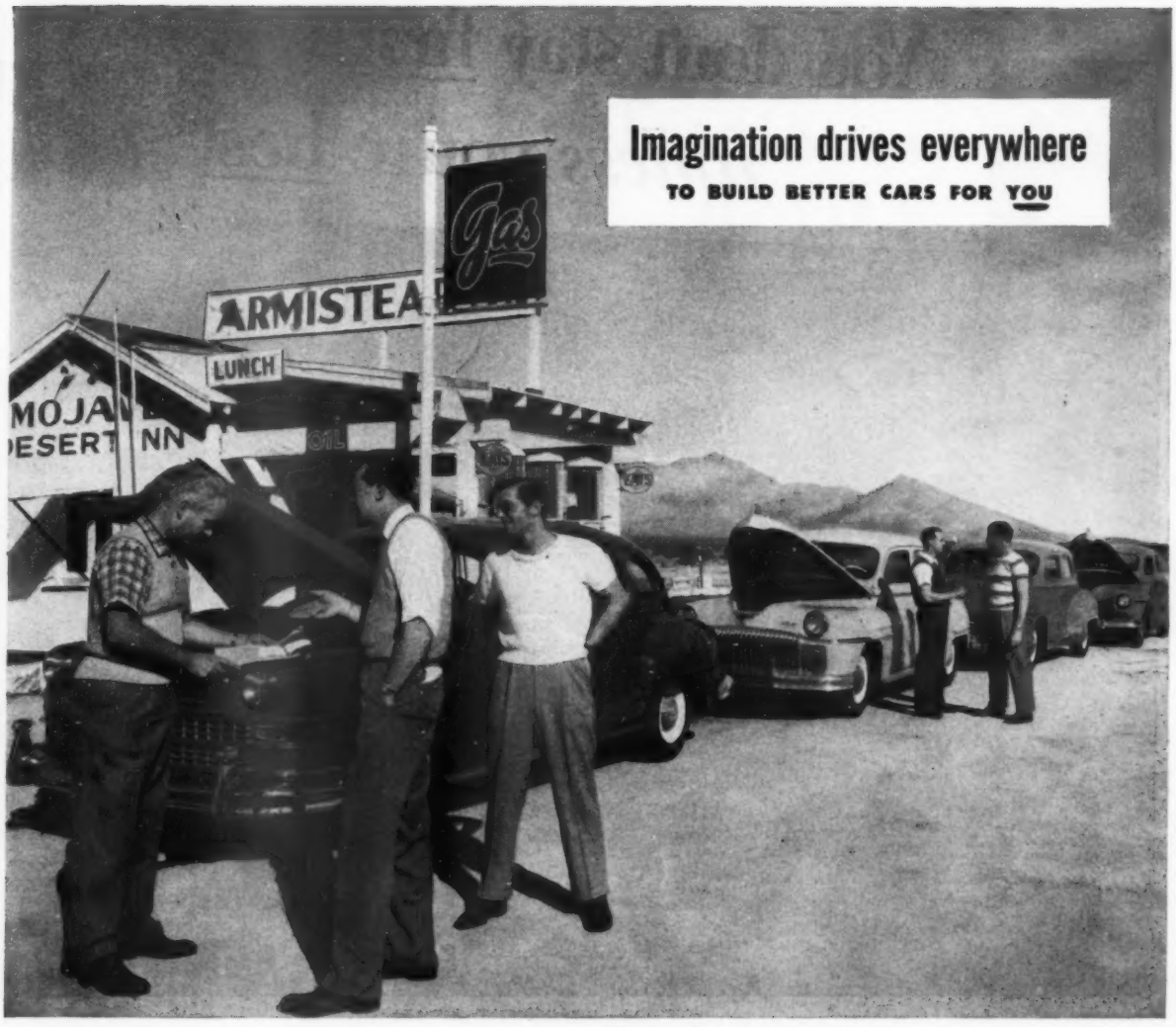

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GOODYEAR

VOLUME 49 NUMBER 9

THE TECHNOLOGY REVIEW

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EDITED

AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Photo by Harold M. Lambert

"Says you!"

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"The lesson here is to keep ahead . . . in technical development of aviation"

Symposium address by General George C. Kenney, '11

THE
TECHNOLOGY REVIEW

Vol. 49, No. 9 July, 1947

The Trend of Affairs

Science in the News

FIRST synthesis of a substance with general structural characteristics identical with those of fibrous proteins, the fundamental units of which all forms of animal life are constructed, has been announced by Robert B. Woodward, '36, Associate Professor of Chemistry at Harvard. The new synthetic molecules are at least as long, and probably longer, than any ever made, and can be produced in thin transparent sheets and thread form. This leads Dr. Woodward to believe that the process for constructing this new class of molecules opens new fields of plastics potentially as useful as cellulosics, nylons, silicones, vinyls, phenolics, and bunas.

The new synthesis is especially significant in medicine because it may provide a model for the processes by which the body synthesizes proteins, and may make possible synthetic silk, wool, and fur which are identical in every respect to, and not merely substitutes resembling, the animal-made products. Additionally, it is significant in that it opens the way for the production of molecules heavier than those of virus proteins which, so far, have held the molecular heavyweight championship. The molecular chains already present in natural proteins may be artificially lengthened through the process, with the promise that virus proteins may be modified into harmless organic substances, or that harmful pathogenic bacteria may be rendered harmless or their growth blocked.

The thesis of Dr. Robley D. Evans, Professor of Physics at M.I.T., that atomic studies are responsible for saving more lives than were snuffed out at Hiroshima and Nagasaki (The Technology Review, December, 1946), was emphasized by Drs. George E. Burch and Paul Reaser of the Tulane Medical School in a paper presented before the centennial meeting of the American Medical Association. Their studies show that radioactive sodium atoms, produced in the atomic energy pile at Oak Ridge, Tenn., have thrown light on a fundamental mechanism in congestive heart failure.

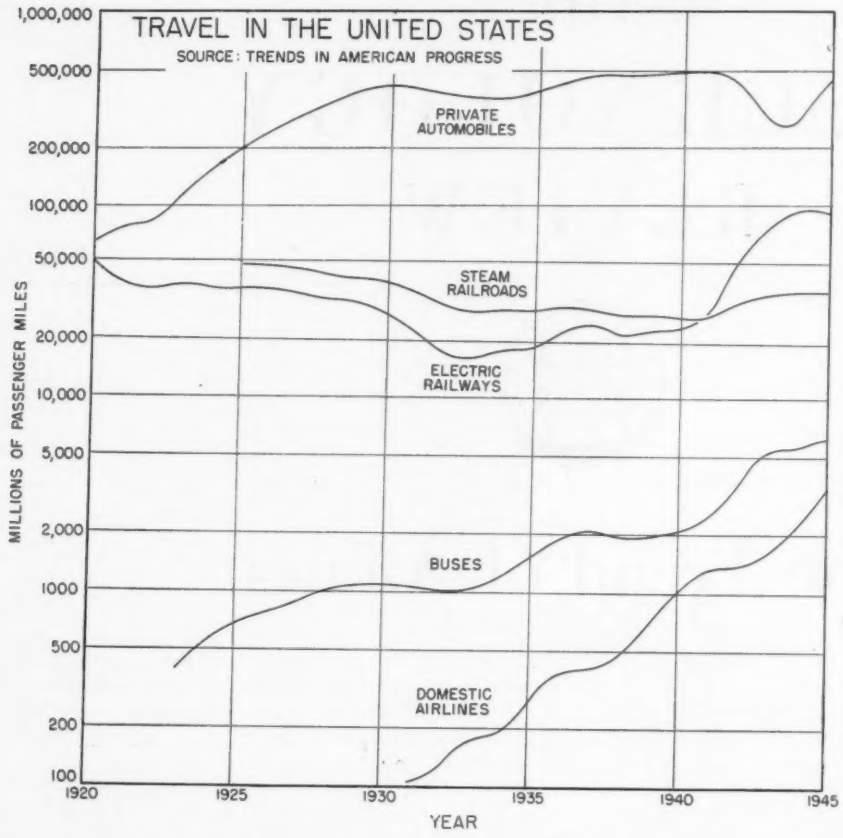
By feeding the radioactive sodium to patients with various degrees of congestive heart failure and measuring the amounts of sodium atoms discharged, it was found that those suffering from heart failure retained 50 times as much sodium as is retained by normal patients. Next was required a method of enabling the patients to rid themselves of the excess sodium. A daily dose of one cubic centimeter of mercurial diuretic, which stimulates urinary secretion, led to the elimination of the sodium tracer atoms and also the condition of congestive heart failure.

Turning from medicine to the field of remote control, evidence was recently presented that much progress has been made since some of the first serious large-scale attempts at radio control were made after World War I. A four-engined Army transport plane made a nonstop flight from Long Beach, Calif., to the Clinton County (Ohio) Airfield on June 11, making the 2,000-mile journey in eight hours and 46 minutes. From the take-off to landing, no human hand touched the controls in the longest "pushbutton" flight on record. Aside from this, nothing unusual happened from take-off to touchdown.

Bell-bottom Screw Jacks

THE announcement that the National Bureau of Standards has issued a revision of the simplified practice recommendation for bell-bottom screw jacks will undoubtedly be greeted with limited enthusiasm. That portion of our population which is intimately concerned with bell-bottom screw jacks appears to be quite circumscribed. But the movement of which this incident is a part cannot be dismissed so summarily. The trend toward standardization and simplification, which is affecting an increasing number of components and methods in our industrial civilization, and which extends occasionally into the sphere of international relations, is one of the more encouraging aspects of our times.

A round of international conferences involving Canada, Great Britain, and the United States has recently gone a



With so much emphasis on the theme of the Alumni Day symposium, "Aviation—Today and Tomorrow," there appears to be little need to look into the history of aviation. And yet, the past proclaims the future, and therefore such a retrospective examination is not without its merit.

The trends in passenger travel in the United States for the past quarter century are portrayed in the graph at the left. As might have been expected, backbone of major travel in this country is the private automobile, accounting for almost half a billion passenger-miles of travel per year. Compensation for the recent slump in automobile travel is made by a corresponding increase in travel on steam railroads and electric railways during World War II.

The comparatively stable long-term trend of growth for steam railroads and electric railways is thrown into sharp relief by the substantial growth of passenger travel on buses and particularly in air liners. Although air lines still account for the smallest number of passenger-miles of travel, during the past 14 years, commercial aviation has shown a trend growth of something like 22 per cent increase per year — substantially greater than that for any of the other services over the same period.

Prophecy is always a difficult and uncertain pastime. Nevertheless, if the present rates of growth of travel are maintained, travel by domestic air lines may be expected to exceed bus travel about 1948. With the same assumption, domestic air lines may be expected to carry as much traffic, about 1956, as electric railways now carry, and, by 1960, domestic air lines may carry as many passengers as are now transported by steam railroads.

long way toward making thread forms and pitches uniform through most of the English-speaking countries. In the matter of fine instrument threads, the Swiss are also being consulted. Even the metric system is not an unbridgeable barrier, for 16-millimeter film and certain metric dimensioned ball bearings are among the relatively few items which are standard on a world basis. The need for international standards was brought out emphatically during the war, when superficially similar designs were found not to be interchangeable and were far more difficult to maintain because of differences in such apparently minor items as threads, tolerances, and methods of assembly. The monetary losses associated with these discrepancies and with differences in the preparation and interpretation of drawings are estimated to have run into the hundreds of millions of dollars.

With all the work that has been done to reduce variations in the more common components used in industry and the home since World War I, it would seem difficult to find more items to standardize, yet activity in this direction is increasing. The field has a publication, *Industrial Standardization and Commercial Standards Monthly*, and a course on this subject has been started at Columbia University.

Efforts are being made to put foreign trade statistics on a truly comparable basis. At first glance it may not seem very important that to most Latin American countries soap is soap, whereas to the customs men of Mexico there are 11 classes of this substance, but analysts can become confused when imports of textiles are measured by yards in one country and by weight in another, or when classifications differ in meaning. A suit which is size 36 in the United States is size 47 in Belgium, size 38 in France, and size 4 in Ireland. A size 37 collar on a shirt calls for no comment in Europe; the measurement is in centimeters. Spark plugs, which were partially standardized early in the century, have been rather badly unstandardized by technical advances. This is a common cause for the continual revision of standards. For the vast majority of industrial items there is no compulsion to use standard parts. The specifications are arrived at by common consent and are adhered to because it is generally immensely profitable and timesaving to do so. But if a designer encounters a good reason to make a new version of a previously standard item, there is nothing but economics and sound engineering practice to stop him. In the case of spark plugs, standards set up several decades ago could not serve for new engine designs, new fuels, and the airplane. With the world's production of automobiles and planes dominated by American practices and mechanisms, there is now a need for international agreement on sizes and types.

Although some standards, such as the cubit, are quite ancient, the large-scale creation of standards by orderly,

conscious, and voluntary action is a phenomenon of the 20th Century. Most of the national standardizing bodies (there were more than a score in 1939) were set up during or after World War I. The oldest group of this type is the British Standards Institution, which was set up in 1901. The great incentive behind standardization is that it frees effort for more productive purposes than making minor decisions in fields where similar decisions have already been made countless times before. Without standardization, complexity would degenerate into chaos.

First Night Flight

By Fred C. Kelly

WITH their cities devastated by night bombers, one wonders how many Germans remember that the first flight of an airplane after dark was made in Germany. This epochal event occurred toward the end of September, 1909, at the Dormstedt military parade ground near Potsdam. A young man had been demonstrating the first airplane ever seen in Germany. He hoped that it would prove to be an instrument to prevent war; that the threat of bombs on buildings housing any government that declared war, would put an end to wars. The German Kaiser, an interested witness at some of the flights, may have had different ideas; certainly one of his successors did.

One evening the young pilot stayed in the air so long that he found himself in darkness when ready to land. The crowd of spectators sensed that darkness had come more quickly than the pilot had realized. The Germans, not yet corrupted by Nazi ideas, were a courteous and considerate people. As if by common impulse everyone who had an automobile turned the headlights toward the landing area, and the young flyer landed safely without mishap. The name of the flyer was Orville Wright.

Piper's Fancy

PIPE installations in any manufacturing plant must be strong mechanically, and must resist corrosion. In food manufacturing, equally important necessities are sanitary construction and adaptability to easy cleaning. A secondary requirement for many installations is some means of identifying the contents of each pipe.

In the past, pipe made of borosilicate glass, sold under the trade name Pyrex, has found some use in manufacturing, because it meets ideally most of the requirements just outlined. Its corrosion resistance exceeds that of any available metal piping. Sanitation is easy because macroscopic dirt within the pipe is visible, because cleaning operations may be watched directly through the pipe, and because glass piping is readily made with sanitary demountable fittings. Identification of contents is axiomatic, since anything inside the pipe is directly visible.

Then why has glass piping not found wider use? Custom and earlier industrial practices provide some of the answers to this query. Plant engineers are accustomed to doing pipe fitting on the spot, with a bench at hand to cut, thread, and join pipe to fit the situation, whereas, on the other hand, until recently, glass piping had to be obtained in prefabricated shapes and sizes which were made in advance by the pipe supplier from exact and detailed drawings submitted by the user. This practice not only hampered new installations of glass pipe, but also limited flexibility in altering installations to follow seasonal changes (common in the food field), to improve manufacturing procedure, or to permit emergency adjustments. Ordinary soda-glass tubing has long been fabricated in laboratories, but the procedures there used are not adaptable to assembly of glass piping for industrial use, both because of the toughness and high-melting point of the borosilicate glass, and because of the large diameters of much of the piping.

New models of aircraft are announced annually; each better in several respects than its predecessor. Each, in turn, merits and enjoys a more or less prominent place in the annals of aviation but is ultimately replaced by a newer and better successor.

Patriarch of today's fleet of sky ships is the Wright Brothers' biplane enshrined at Philadelphia's Franklin Institute. Pressurized cabins, instrument landing, and ground-controlled, approach radar systems were to be unknown for decades after this plane first soared into the air under its own power. But age rests lightly on this structure of bicycle parts and wooden struts reputed to be the oldest plane still in flying condition

Photo by Chester from Black Star

These obstacles to on-the-spot fitting of borosilicate glass pipe were overcome during the installation of seven and a half miles of glass pipe, in sizes up to four inches diameter, in the plant at Oak Ridge, Tenn., where U-235 was made for atomic bombs. Special devices and procedures were developed for cutting, forming, welding, and annealing, with all of these operations performed on portable benches, comparable to the conventional pipe fitter's bench.

Cutting was accomplished by localized application of heat from a resistance wire carrying an electric current. The glass was scratched with a file at the point where the cut was to be made. A single turn of Nichrome wire was then applied tightly around the pipe at this point, and current controlled by an autotransformer was passed through the wire. After sufficient heat was generated, the wire was removed and a wet cloth applied to the pipe. The consequent sudden cooling of the locally heated pipe caused a strain that snapped the pipe cleanly at the scratch mark.

Forming and welding of borosilicate glass in large sizes are hampered by the fact that even at the temperature of the oxyhydrogen flame, this glass cannot readily be brought to its melting point without localized overheating. At Oak Ridge this difficulty was overcome by taking advantage of the electrical conductivity of glass at high temperatures. Two opposing oxyhydrogen flames were used, with the terminals of a high-frequency oscillator connected to the burners. After the glass was sufficiently heated by the flames, the high-frequency current was turned on, and this current passed through the flames and flowed through the glass. Because of the resistance of the glass, it was quickly and uniformly raised to its melting point.

The third and final obstacle that had to be surmounted in on-the-spot glass pipe fitting was provision of some means for annealing. In the heat-forming and welding of glass such strains are created that if the glass is allowed to cool freely it is extremely brittle, or may even shatter spontaneously as it reaches room temperature. Removal of such strains is accomplished by an annealing operation in which the temperature of the glass is raised almost to its melting point, after which controlled cooling lowers the temperature uniformly and slowly. Conventionally, annealing of glass is done in large permanent ovens, a procedure obviously impractical in on-the-spot glass pipe fitting. At Oak Ridge, portable electric furnaces were developed for annealing. These furnaces were essentially cylindrical jackets, containing electric heating elements, that could be closed around the fabricated pipes, heated to the necessary temperature, and cooled at the desired rate. A portable polariscope was provided to verify effectiveness of annealing; under polarized light, strains in glass show up as brightly colored bands or areas of spectral hue.

Ingenious and useful as are these recently developed techniques, still they do not yet make borosilicate glass ideally suited for all industrial uses. Even the tough borosilicate glass is not as strong as metal. Its use, therefore, is limited to those locations where it can be protected from mechanical blows or stresses, and even from severe vibration. But substitution of transparent tubing for its stronger metal counterpart has advanced far beyond the stage of being a mere pipe dream.

Sky Fire

THE 1946 publication, *Fire and the Air War*,* "a compilation of expert observations on fires of the war set by incendiaries and the atomic bombs, wartime fire fighting, and the work of the fire protection engineers who helped plan the destruction of enemy cities and industrial plants," is of immediate importance to city planners and military strategists, and will interest a widely diversified group which includes members of fire departments and sociologists studying the behavior of people under the stress of danger and disaster.

A strong air force can deliver fire wherever it wishes, and by means of this fire can accomplish — what artillery cannot bring about, what has not been possible in earlier wars — the destruction of the civilian property of the enemy in places far removed from military operations. World War II has demonstrated that the destruction of the enemy's civilian property is a most effective way of procuring a military victory, and it has shown that fire whether from incendiaries or from atomic bombs is far more efficient than explosives as a means of doing it.

The present book describes the measures which the civilian populations of Britain, of Germany, and of Japan took during the war to protect themselves against fire and to deal with it when it was rained upon them, and describes the frightful damage which it caused to persons and to property.

Approximately four-fifths of all the war damage done to English and German cities was the result of fire. The pre-atomic bombings of Japanese cities were fire raids. It has been estimated that the physical damage caused by the atomic bomb at Hiroshima was about the same as would have been caused by 1,300 tons of other bombs (one-fourth high explosive and three-fourths incendiary) within the target area, and at Nagasaki by about 600 tons (three-fourths high explosive and one-fourth incendiary) within the target area. To complete the estimate, additional antipersonnel fragmentation bombs must be included to account for the casualties.

The 15 chapters which comprise the book are the work of nine experts, among them the Chief of Fire Staff, British National Fire Service, the Chief Fire Marshal, Chicago Fire Department, and the anonymous author of the Official Report of the United States Strategic Bombing Survey on "The Effect of Atomic Bombs on Hiroshima and Nagasaki." This report constitutes Chapter 14, pages 194–240. Its author, after discussing the various means of protection which may be employed against atomic bombs, concludes that: "One further measure of safety must accompany the others. To avoid destruction, the surest way is to avoid war." The last paragraph of Chapter 15 is also the last paragraph of the book the purport of which it summarizes as follows:

"World War II demonstrated that planned destruction of large areas of cities could be accomplished. The destruction is easier with the atomic bombs. The greater the fire vulnerability the more certain enormous loss of life in event of such attacks. He who would make his nation strong must look to its fire defenses as well as to its armed forces." — T. L. D.

* Boston: National Fire Protection Association International, 1946. xii + 262 pages. $4.00. Edited by Horatio L. Bond, '23, Chief Engineer, National Fire Protection Association.

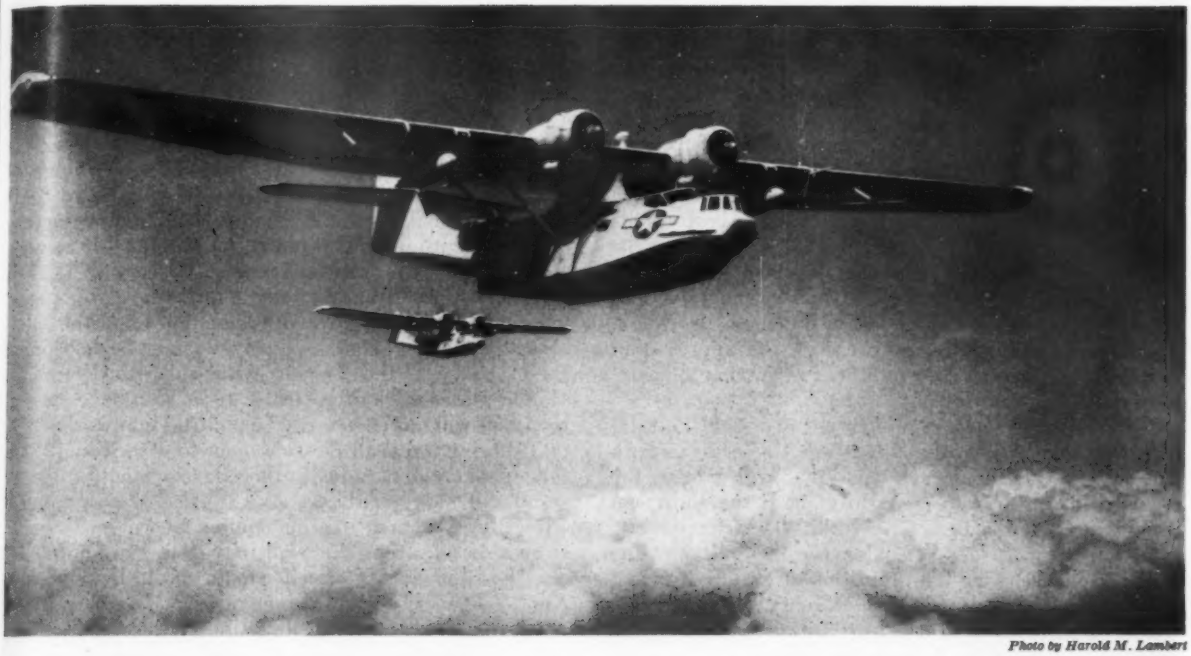


Photo by Harold M. Lambert

Research for National Defense

Scientific Research, Actively Pursued, Plays a Double Role. It Is Desirable in Raising Our Standards of Comfort; It Is Imperative for Our National Security

By George C. Kenney

At the conclusion of any operation, whether it be the building of a bridge, manufacturing 1947 model automobiles, or fighting a war, it has become standard procedure to sit down and study the reports, analyze the events that occurred, see what mistakes were made, why they were made, and how much they cost. From this analysis we are supposed to find out how to do the job better next time. In the case of the bridge builder and the automobile manufacturer, the scheme works quite well. The bridge builder keeps right on building bridges and the automobile manufacturer starts on his 1948 model as soon as he has finished with the 1947 line. The conditions of the problem do not change much from one operation to the other.

In warfare, on the other hand, a period of perhaps 20 years elapses between wars. New weapons are developed which in turn influence tactics and strategy and even dictate the location of battles and campaigns. If military men do not keep abreast of such developments and correctly evaluate their influence, they are liable to be accused of trying to fight the last war instead of the present one. The losers in most wars, as a matter of fact, have done this very thing. Napoleon defeated many generals who were still thinking in the past. In World War I, the stalemate and the continual slugging match that won or lost a few yards of ground, can be attributed to the fact that both sides were merely continuing their previous wars. The blitz warfare of the second World War, with its use of air power and mechanized forces, smashing through the strongest defensive positions and quickly gaining the decision, almost gave Germany world dominion. Hitler was finally defeated only after the Allies had learned how to "out-blitz" him.

After six years of struggle and the subsequent analysis of events, there are certain definite conclusions that we can make. Certain methods and weapons should be further developed, others should be modified to meet changed conditions, and still others should be discarded as obsolete and on which it is no longer worth spending our national defense appropriations.

Air power has become the decisive element in warfare. The conflict is opened by air power and the first action is an air action. Air power is the only means of defense against air attack and the battle for control of the air must be settled before the surface forces of the winner can get under way. In fact, the winning of the air battle has become so decisive that in the future the role of surface forces may very well be that of mopping up die-hard detachments and guerrillas and completing the victory by occupation and administration of the enemy country. Today the world is at the mercy of the airplane.

Air-borne operations, with the flying of troops, sup-

plies, and reinforcements to the scene of operations and the evacuation of casualties, will bring us up to date on an age-old basic principle of war illustrated so picturesquely by General Nathan Forrest when he said: "Git thar fustest with the mostest."

Our analysis of past battles and campaigns, however, must be more than cultural. To analyze Pearl Harbor simply as a "sneak attack" would be wrong. To conclude simply that aircraft could sink or damage naval vessels would be insufficient. Actually, we had known that for years. The real lesson was that our national defense organization was wrong. We had plenty of warning. We had enough fighter defense to defeat the Japanese air attack. We had everything necessary except the appreciation of what air power could do and the organization to insure that something was done.

We are now in the throes of trying to correct that defect by unifying the Army, Navy, and Air Forces under a single head. As a matter of fact, that will give us the organization we had to come to in both the European Theater and the Pacific before World War II was over.

In February, 1945, Corregidor, the "Gibraltar of the East," stood blocking the utilization of Manila Bay and the docks and harbor facilities of Manila itself. Corregidor was bristling with coast artillery, antiaircraft guns, and machine-gun positions. It had ample supplies of food and ammunition and was manned by a garrison of approximately 8,000 fanatical soldiers ordered to stay there and hold the position at all costs for the glory of the Emperor and Greater East Asia. Four thousand tons of heavy bombs, dropped in 10 days, reduced the defenses to rubble. A parachute regiment of 1,800 men descended on the parade ground on the western end of the rock and 2,000 more men rowed across the harbor entrance from Bataan and landed on the beach. A few scattered rifle shots were fired and Corregidor was again American territory. Mopping-up operations to dig the Japanese survivors of the bombardment out of their caves took a little longer but the so-called impregnable fortress had fallen to the bomb carried by aircraft.

Looking to the Next Decade

The lesson went beyond the facts that this operation was brilliantly executed and that it was successful. It settled for all time the question as to whether or not we should spend our national defense appropriation on fortresses. It sounded the death knell of the fortress.

An analysis of World War II also brings out the tremendous advantage that superior equipment carries with it. With anywhere near equal forces, that force with the superior equipment wins. This was particularly true in aviation. Neither the Germans nor the Japanese could match our bombers. American bombers had more range, carried bigger bomb loads, were faster and were better defended than anything produced by our enemies. While at times both the Germans and the Japanese produced fighter aircraft that excelled ours in some particular characteristic, ours had more range, better bullet-proof tanks, better armor, more structural strength, and were better all-around combat weapons. The record of victories bears this out in both theaters.

The lesson here is to keep ahead of any possible enemy in technical development of aviation. If we maintain a lead in technical development of aviation, we will have gone a long way toward insuring that we win the air battle in any future war. If we win the air battle, we cannot lose the war. In planning for that air battle we must visualize the weapons we and the enemy will have at that time and modify our tactics and strategy accordingly.

We must constantly look ahead five to ten years. Nine years from the time we began planning for an airplane like the B-29, it began flying over Japan. Five years elapsed from the time the B-29 was on the drawing board to its first operational mission. Even under the drive of wartime effort and with unlimited funds, we were unable to get a new airplane into operation between December 7, 1941, and August 14, 1945. We fought that whole war period with aircraft types already in production when the Japanese hit us at Pearl Harbor. Today, we must be developing the aircraft and the weapons with which to defend the United States in 1952 and 1956. If we stop development today we will not necessarily be plunged into war in 1948 or 1949, but we shall be wide open to attack in 1952 if other nations go ahead with their developments while we stand still.

In a few years our existing equipment will be obsolete. Others, besides ourselves, will have atomic bombs. Jet and possibly rocket-driven aircraft will be standard equipment everywhere for air combat and bombing. There seems to be no practical limit in sight for speeds and ranges, particularly if atomic energy power plants are developed for aircraft. The time elapsing between the decision by some future aggressor to attack us, and the actual attack itself, is rapidly becoming a matter of a few hours. Unless we can find a way of defeating that attack, or can show so devastating a power of retaliation that no one will dare to risk the consequences of war against us, we may suffer so appalling a casualty list in the first 24 hours that, coupled with the accompanying destruction of our industries, the nation may be unwilling to endure further punishment and decide on capitulation.

We need a warning service extending as far out from our centers of industry and population as possible. We need fighters, constantly on station to take off on receipt of warning that strange aircraft are headed in our direction, challenge such aircraft and force them down, or shoot them down, if they cannot identify themselves as friendly. We already do this with surface vessels. That is what we have the Coast Guard for. No ships steam into our harbors without getting the proper clearances before they leave their home ports. We shall have to do the same thing with aircraft.

Our primary insurance, however, will be our long-range striking force of bombers and their accompanying fighters capable of striking any target anywhere in the world at a moment's notice. This force should be capable of matching bomb tonnage with any possible enemy. No would-be Hitler of the future is going to attack us if we can not only defend ourselves, but by retaliatory action, can destroy him. No future aggressor would even hesitate to attack us if we are defenseless or cannot trade punches with him.

Tasks for Research

This brings us to the part to be played by science and industry, both of which you represent. We need a lot of things that only you can produce. I will mention a few as illustrations. There are many more, and the chemists, the physicists, and the engineers of the world are continually searching for the answers. (*Continued on page 576*)

Photo by Harold M. Lambert

Air Transportation — Today and Tomorrow

A Healthy Air-transport System, Calling on International Ports, Is Essential for Peaceful Commerce and an American Electorate Conscious of World Affairs

By John C. Leslie

AIR transportation will be advanced to new heights of usefulness and prosperity through the work of the scientist and the engineer. The basic problems are still those of building safer, faster, and cheaper aircraft, of providing efficient airways and airports, and of fitting these machines to human capacity. This is what science and engineering can and will do. Great advances have been made since the early days of aviation, but they should not deceive us. Despite an impressive record of accomplishment, the future of aviation is greater than its past. Make no mistake about it. In absolute terms, air transportation is years removed from technical maturity.

Technical effort alone will not develop the full potential of the industry. Money has always been a problem, and is so now more than ever. Aeronautical research is becoming incredibly expensive. The price per unit weight of high-performance transport aircraft is constantly rising. Major sums of capital are required for the development of airways and airports. Under the American system, to which I am sure we all subscribe, an opportunity for reasonable profit in the aircraft manufacturing business and in the air-line business must exist if additional private capital is to be attracted to the job.

Beyond the financial problems are large areas where politics and diplomacy determine the progress of the air-line business. The air liner uniquely brings to governments, both local and national, mixed considerations of public convenience, commerce, prestige, national defense, and military power. The sword and the plowshare are sometimes almost indistinguishable in the transport airplane.

Only the soundest kind of long-range thinking and planning can tune these dynamic elements to the good of the public and the peace of the world. I do not presume to give you the tuning formula. By considering each of the principal factors, however, I hope to give you some added basis for interpreting — and shaping — the news.

Airplane Development

Progress in the past has depended on a tacit division of responsibility. The universities — with our own M.I.T. in the lead — have trained the engineers and have sustained the professors in their programs of pure research. The Government, through its civilian and military agencies, has done the major portion of research requiring large facilities. The armed forces, through contracts with private manufacturers, have developed virtually every large power plant. Private capital has taken the basic research and the military power plants and produced our air liners. This is a scheme well proved in practice. It would be folly to abandon it in favor of any plan which, in effect, would put under government control the produc-

tion of standardized aircraft types for sale to the air lines. The basic way to avoid this folly is to see that the air lines are kept in sound financial condition under honest, economic, and efficient management. It is equally essential that the Federal budget provide adequate funds for a consistent long-term program of military research.

The Air Liner Today

I dare say that many of you are not really familiar with today's air liners, for they are just now coming into service. I refer, of course, to the Douglas DC-6 and the newest Lockheed Constellation, both of which may be placed in the same general category. They are large, four-engined machines, carrying 50 to 60 passengers, cruising at from 300 to 325 miles per hour, and operating at maximum gross weights of from 90,000 to 100,000 pounds. They can fly with reasonable economy from London to New York with not more than one intermediate stop. Naturally, they have pressurized cabins to permit flight above the weather and to eliminate ear discomfort during descents. They provide many new niceties for comfort.

This year two new aircraft built for shorter ranges will undergo the qualifying tests of the Civil Aeronautics Administration, the Convair 240, and the Martin 303, both two-engined aircraft. They will carry about twice as many passengers, will weigh about 50 per cent more and will be from 100 to 120 miles per hour faster than the famous Douglas DC-3 they replace.

Finally, America will produce this year the big, new Boeing Stratocruiser, a transport development from the B-29 Superfortress. Cruising up to 340 miles per hour, its double decks will carry as many as 80 passengers on the long transcontinental and transoceanic routes.

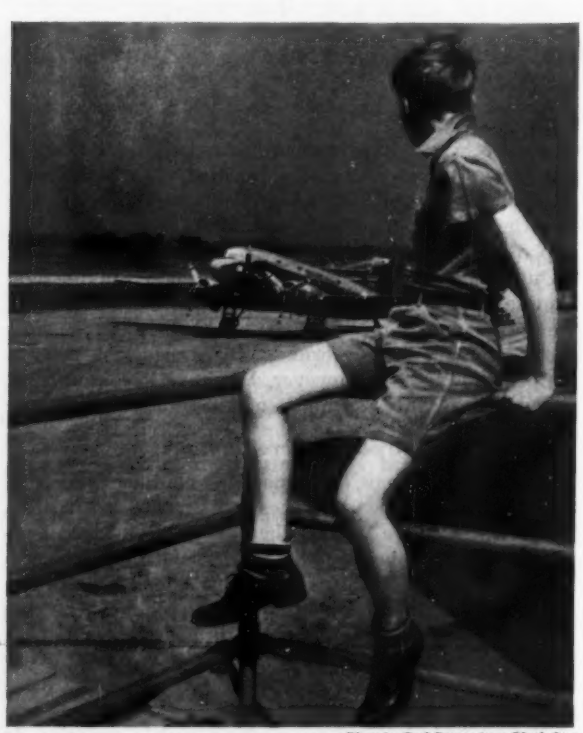


Photo by Carl Berger from Black Star

Many families of moderate income would like to tour foreign lands at least once while their children are of teen age. Aviation now provides that opportunity.

I am sorry to say that is the end of the roster. The 400-mile-per-hour Republic Rainbow was in an advanced stage of construction when cancellation of a purchase contract by one of the air lines — a real tragedy for American aviation — brought the project to a halt. One must hope that some measures will be taken, perhaps involving both the armed forces and the commercial air lines, to get this project under way again. Few people realize the alarming fact that although certain foreign countries are pursuing definite programs for the construction of new air liners, there is not a single new commercial transport type on order in the United States today beyond those which I have mentioned as being scheduled for delivery this year. Failure to match foreign equipment was one of the reasons for the defeat of our merchant marine on the high seas when the sailing clippers were outmoded.

The Air Liner of Tomorrow

One cannot talk about the future air liner without fixing the importance of speed. Naturally, what the air lines have to offer the traveler is speed, but there is more involved than that. What air lines must also be able to offer is economy, or more plainly, low prices. A potential mass market exists, especially on the international routes. Think how many families of moderate income there are in this country who would like to take a trip at least once, when the children are of teen age, to Europe, or Rio, or Honolulu, but who simply cannot do so by steamship within the customary two-week business vacation period. By air, they could fly over on Friday night, spend two full weeks abroad, and come home the last week end, ready for work Monday morning. This would be the kind of traffic the air lines like best for it is created, not diverted, from other means of transport. For our nation such travel would build an electorate newly conscious of the world in which we live. The air lines need only reduce the price down to a level which the ordinary family can afford.

You may wonder why I raise the question of price here. The answer is that speed can have a lot to do with economy. Usually the effect of high speed is adverse, but not necessarily in the case of aircraft. The air liner's produce is passenger-miles (or ton-miles) per year. Many important elements of cost are primarily determined by the passage of time rather than mileage; for example, depreciation, flight crew salaries, and many aspects of maintenance cost. If such costs are fixed in relation to the calendar, it is plain that passenger costs per mile may decrease as the speed of the vehicle increases, provided the added speed comes from increased efficiency and not from "main strength and awkwardness."

Fortunately, the scientists and the engineers have been contributing the added efficiency. Probably the propeller-driven air liner approaches its efficient limit in the vicinity of 475 miles per hour. Now, however, we have at hand a new means of propulsion — the turbo-jet. Its efficiency becomes high at speeds in the vicinity of 450 miles per hour. I profess no expert knowledge, but I have not the slightest doubt that we shall all be riding in jet-propelled air liners at speeds of at least 500 miles per hour. When that comes to pass, I am sure there will be a further lowering of the price to the public. Incidentally, there are indications that the turbo-jet power plant will ultimately be cheaper to maintain (*Continued on page 570*)

Future of Gas Turbines in Aircraft

Much Research Is Needed to Surmount Present Limitations but the Gas Turbine Has a Promising Future for Use in Tomorrow's Aircraft

By Arthur E. Raymond

At a time when so much research is being undertaken on the development of new gas turbines, it is natural to ask: "What are we going to use gas turbines for?" My experience outside the aircraft field is meager, but within that field it is possible to visualize a great future for these new sources of motive power.

Gas turbines, as I would define them, comprise that class of engines in which, after compression and the addition of fuel, the hot gases act directly on a rotating member, rather than indirectly through reciprocating parts.

The energy of the products of combustion may be released through conversion to high velocity, as rockets make use of it, in which case we have the so-called jet engine, or turbo-jet. The hot gases may also be passed through additional turbine blades and transformed into mechanical energy to drive either a fan or a propeller, as in the ducted fan or in the propeller turbine, more commonly called the turbo-prop. In all these variants the initial cycle is the same. Even when a propeller is used, some of the energy of combustion is not recovered by the turbine and acts as a jet, so the jet is, in some measure, common to all.

Why are these engines supplanting the reciprocating types for so many of the products of aeronautical engineering and wherein lie their advantages and disadvantages?

First of these new engines to be used was the turbo-jet which made possible greater speed of aircraft. The turbo-jet was first employed in extremely fast intercepter aircraft because the jet engine is a device whose power and appetite for fuel change more favorably with speed and altitude than do those of its propeller-driving brothers. Thrust, or the force driving the airplane, remains more or less constant in jet-engine planes whereas it falls off almost directly with speed for propeller-driven airplanes. The decreasing temperatures at high altitude have much greater beneficial effects on the low temperature turbine cycle, than on that of the reciprocating engine where the maximum temperatures are high. Although the jet engine is light, this advantage is lost if it becomes necessary to carry along the fuel to operate it for a long time, for it is a notorious fuel eater. All things considered, it is ideal for the intercepter type of aircraft which has to get aloft in a hurry, pursue the other fellow, and make its kill.

Conversely, at low speeds the propeller engine delivers its greatest thrust and is more effective than the jet engine. Except in extremely high-powered airplanes, the use of jet engines implies the use of longer runways than would otherwise be required, or the use of catapulting devices as employed by the Navy. The pickup in speed after leaving the ground is slow in jet-propelled aircraft and it is difficult to eliminate the engine thrust completely during the landing operation. If the jet engine is slowed down materially, a greater than normal interval is required to get it up to power again. All in all, the jet airplane is a flashy thing in the air but on or near the ground, during take-off or landing, it acts as though the air were made of molasses.

One other thing is against it. For some reason, hidden in the recesses of the innermost secrets of combustion, the jet also has a disturbing tendency to quit altogether at certain speeds at high altitude. This is termed "blow out." Just how well a jet engine acts in this regard depends on a lot of things, such as temperature and whether the month has an "R" in it.

The deficiencies of the jet engine have led designers to clamor for the addition of a propeller. The turbine portion then becomes a relatively constant operating device and the thrust application is derived from the pitch change of the propeller, while additional thrust can still be obtained from the remaining jet blast. A propeller gives much more push at lower speeds and lower altitudes and it can be made into a very good brake as well. And so we have seen the development of the turbo-prop engine.

But the turbo-prop engine is not the answer to everything, either. Not only is the propeller, its controls, and its gearing an intricate piece of machinery but it loses efficiency if the speed is too high and it likes good thick air into which to bite. At high speed and high altitude, its efficiency drops until, as the speed of sound is reached, the propeller fails altogether. The propeller does help the jet engine in take-off and enables it to get lower fuel consumption per mile. For these reasons the turbo-prop engine has been used in long-range bombers and similar aircraft.

The good old reciprocating engine with propeller still leads the field in low fuel consumption and its manufacturers have a few tricks up their sleeves to increase its effective thrust per pound of weight. Also, a reciprocating engine lives to a much more venerable age than its newer turbine brothers and has to go to the hospital much less often. The most highly developed of the radial engines habitually go 1,000 hours between overhauls, whereas the turbo-jets do well to last 200, and the turbo-props — well, the less said about them right now, the better. A few years from now there may be a different story to tell. In the meantime, much research, much development, and much use of laboratory facilities will be required.

Superficially, it would appear that an engine in which all motions are continuous and smooth would last much longer and be easier to design than one in which important parts must reciprocate rapidly. This may be so eventually. Today, the requirement that parts rotate at high speeds while at high temperatures, and the necessity for the ut-

Photo by Harold M. Lambert

The military services are far better able than commercial aviation to pioneer in the development of jet-propelled aircraft. The coming of the jet transport will bring to civilian aviation new problems of design and traffic. The traffic control systems will have to be more universally used and will have to be much better than they now are.

Photo by H. Armstrong Roberts

most in efficiency of each component, both combine to create a problem of enormous magnitude in design and materials. In addition, testing of the individual parts becomes difficult and extremely costly because of the tremendous amounts of power which are transmitted internally. People have been misled by the apparent simplicity of this type of engine; they are learning that its development requires just as much time and money as its supposedly more complicated predecessor. That turbine engines are so simple that they can be specifically tailored to each type of airplane, or perhaps to each model of airplane, is proving to be an illusory idea.

Nevertheless, performance counts and the gas turbine is bound to find extended application as time goes on. If the proper jet or propeller type is chosen for the particular use one has in mind, the gas turbine is one of the most efficient power plants available to man in terms of thrust produced relative to weight.

One word about commercial, rather than military, uses may be in order. The military applications should and will come first. Because the military services are more concerned with performance and less with safety than commercial services, they are far better able to pioneer in the development of gas turbine engines and aircraft. But in due course there will be jet transports. With them will come problems in civilian aviation arising from the special characteristics of jet-propelled planes.

The jet emerging from the tail pipe of a turbo-jet is hot and its velocity is high. While the airplane is being turned around on the ground under its own power, the jet cannot be blown at bystanders with the same nonchalance as the slip stream of the propeller. Very possibly, jet transports will have to depend on tractors or other ground-handling equipment to move them about amid other aircraft and in the vicinity of servicing or loading operations.

In flight, the jet transport will have to go direct to its destination and land in rather strict accordance with a previously outlined flight plan. It cannot move on to alternate landing fields in case the first one is closed in by weather, nor can it mill around in a stack with other airplanes waiting to land. To do so would impose a prohibitive weight of reserve fuel, for the fuel consumption per hour will be large even though it may be much less than it is now. Low speeds at low altitudes are not the proper environment for jet engines.

The greatest efficiency for jet-propelled aircraft will occur at altitudes higher than are common at present and a prematurely enforced descent will shorten its range and endanger its ability to travel the required distance. Therefore, pressure cabins will have to be designed to operate at higher pressures and they must be even more dependable than they are now. Operation over short distances will be comparatively expensive because there will not be enough time to ascend to the most efficient flying level and descend again. For the same reason a strong head wind aloft cannot be so easily circumvented by flying at a lower altitude.

To these operational problems will be added new and serious obstacles in landing and take-off. The presence of jet-propelled aircraft, entering or leaving the traffic pattern around an airport on a rapidly ascending or descending path and at a much higher rate of speed than the balance of aircraft, will introduce new traffic hazards. The problem is magnified by the practical requirement that when jet-propelled planes come down to land, they must be allowed to land almost (*Continued on page 568*)

Problems of Management in the Atomic Energy Commission

For Commercial Use as Well as for National Security There Is Need to Create an Atomic Industry

By Carroll L. Wilson

Alumni Day Banquet Address

THE atomic energy field is a big one; no one really knows yet how big it is. It stretches beyond geographical boundaries and beyond conventional horizons of national thinking. It combines major scientific problems with impressive problems in management and public policy. Solving these problems is not a task merely for scientists at Oak Ridge, Hanford, and Los Alamos, or for the small group of members of the Atomic Energy Commission in Washington. Nothing, short of understanding and wholehearted assistance from the entire nation, is going to assure that atomic energy makes its full contribution to national security and technological advance.

As M.I.T. Alumni, you already know something of the size of the problem. As a matter of fact, many of you have had close connection with the project. President Compton, as chairman of the Joint Chiefs of Staff's Evaluation Board on the Bikini Tests, knows probably as much as anyone about the military implications. Professor Robley D. Evans, in charge of the Institute's large program on the applications of radioisotopes to industry and medicine, has great familiarity with these peaceful applications of atomic energy. The Atomic Energy Commission and its staff include many M.I.T. men, such as Brigadier General James McCormack, '37, Director of the Commission's Division of Military Application, and Dr. James B. Fisk, '31, our Director of Research, for example. The Institute cannot fail to take pride in its outstanding contribution in this field — during and since World War II.

It is perhaps natural that I should discuss some of the problems of management in this unique enterprise which is a strange combination of government and private endeavor. Many, and perhaps most, of you have managerial responsibilities in your business activities. You have problems of production, of getting the materials you need, of providing fiscal controls, of working out wage and salary policies, of conducting research to keep ahead of your competitors, of selling your products or services, and last, but not least, problems of earning money. The framework in which you work is changing all the time, both as a consequence of what you and the rest of your industry do, and as a consequence of governmental action.

In managing the affairs of the Atomic Energy Commission we have most of the same problems as private enterprise and a great many more, but let me first describe some of the main elements of the business of the Commission. Under the 23-page Atomic Energy Act passed on August 1, 1946, after long and searching inquiry by the Congress, numerous aspects of atomic energy are made a monopoly of the Government in the sense that the Government must control many activities and operations in this field. Responsibility for exercising such control on behalf of the Government is vested in the Atomic Energy Commission. Such control may be exercised through direct ownership and operation; through Government ownership but with operation by private contractors; through licenses and regulations, and by various other means. At the present time, the principal means through which the Commission exercises control is through ownership of materials, plants, and laboratories operated by private, industrial, or educational institutions under contract with the Commission. Through the devices of more than 300 contracts, the Commission operates facilities and carries on research and production in Government-owned properties representing a capital investment of nearly two billion dollars.

We may find that certain types of operations can be done more effectively if operated directly by the Commission. It is likely, however, that these may be the exceptions rather than the rule.

The Commission has a monopoly in the control, direction, and responsibility for atomic energy in the United States. But there is no monopoly in the sense that everything is done by and within Government organizations. In fact, this enterprise is a very large and complex manufacturing business, a vast research and development undertaking, a regulatory organization, and a body charged with the formulation of public policy in a new and unexplored field.

Operations of the Commission

The operating responsibilities of the Commission involve three general types of activity: (1) production of fissionable materials, isotopes, and weapons; (2) research and development directed toward increasing our rather meager knowledge in a field full of great potentialities which, when brought to fruition, may profoundly affect our daily lives just as the military applications have already affected international relations; and (3) management of communities associated with certain major centers of production and research.

The Commission is responsible for manufacturing fissionable materials, isotopes, and weapons. In order to do this job, an intricate series of processing operations are involved. The first stage involves the procurement of special raw materials and their refinement to the form and purity required for the production operations at the plants at Oak Ridge, Tenn., and Hanford, Wash. One of the five major field offices of the Commission is responsible for the procurement and preparation of uranium feed

materials for Oak Ridge and Hanford. To be suitable for feed for the production plant at Oak Ridge, the uranium must be in a pure form of uranium hexafluoride. To be suitable for use at Hanford, uranium must be in a very pure metallic form. Thus, the first stage of an integrated manufacturing process involves preparation of these feed materials and their delivery on schedule to Oak Ridge and Hanford.

In the enormous plants at Oak Ridge, the second stage of production involves the separation of Uranium 235 from the normal isotope, Uranium 238. At the other production center at Hanford, Uranium 235 is burned as fuel to produce a new element, plutonium, which is also a fissionable material. The fissionable materials produced in the separation and burning operations at these two plants are useful both for reactors which, when much further developed, may be useful in the production of power, and for the production of atomic weapons. Thus, the first and second stages of this manufacturing process are the same whether the product is to be used in weapons or for peaceful purposes.

The manufacture of weapons, for which the Commission is also responsible, involves the third stage in the manufacture of fissionable materials. The same materials which are useful in weapons are also needed in research and development. At present, studies are under way to provide knowledge of the behavior of fissionable materials in reactors which now are capable of producing radioisotopes and will later be able to produce energy in a form useful for industrial uses.

The second operating responsibility of the Commission is to conduct research and development directed to the expansion of our very limited understanding of atomic energy. The development of new types of reactors, auxiliary processes and equipment, improved weapons, and better knowledge of the effects of radiations and therapeutic methods for treating those who have been exposed to these radiations are also subjects to which additional research is directed. This is a very broad assignment. While supporting, encouraging, and otherwise stimulating creative work to advance these frontiers, the Commission must be ever conscious of the dangers of too much control of research. A fine balance must be maintained.

The third operating responsibility of the Commission is to manage the communities established in connection with its manufacturing and research operations. At Oak Ridge, for example, there is a Government reservation of 60,000 acres on which has been built a city with housing and services for 40,000 people. The entire site and all buildings and facilities located on it belong to the Government, but the management services in the operation of the plants and the community are furnished by private contractors.

Atomic Energy Plants

In the eastern part of the State of Washington, on the Columbia River, the Commission owns or controls a reservation of nearly 600 square miles and a city with a population of 15,000 people. The weapons laboratory, requiring special features of topography and isolation, is near Santa Fé, N.M., and requires a community of nearly 8,000 people. In each of these communities there are all of the problems associated with city and town management and services, such as schools, public works, fire and police departments, hospitals, recreation grounds, transportation systems, and a multitude of other services needed by any modern community. In addition, the Commission faces the problems of being the landlord and assumes responsibility for maintenance, rent collection, and other functions which go with owning and renting many thousands of dwelling units. Moreover, operations conducted at the Oak Ridge, Hanford, and Santa Fé plants require a measure of isolation. Despite such geographical isolation, if we are to advance our knowledge in this little-known field, it is essential to attract and hold personnel of the caliber required to operate the complex industrial plants in these communities, and staff the research laboratories in which creative scientific work must be done. For example, schools and medical services must meet high standards if scientists, engineers, and administrators are to leave large urban communities to live in the Commission's towns.

Embarking on an Uncharted Course

Another Commission responsibility, but not one involving direct operations, is interpretation of the Atomic Energy Act carrying with it the development of policy on innumerable questions. The Commission is responsible for the control of a vast body of restricted scientific and technical information related to atomic energy, as well as manufacturing knowledge and vital figures related to production and operations. A balance must be achieved between the declassification of information which would accelerate scientific and technical advancement, and the withholding of information which would benefit other nations at the expense of this nation's security.

By regulation and license the Commission must also control transactions involving certain special materials, including uranium and thorium. In addition, it must exercise export control of materials and equipment whose sale to other countries would advance their progress in this field. These controls should be so designed that they will impose the minimum necessary disruption on established commercial practices. The Commission must also administer provisions in the Atomic Energy Act regarding patents and inventions which are wholly novel and involve untried and unexplored administrative mechanisms and technical and economic appraisals.

The work of the Commission is done through about 300 prime contractors and a much larger number of subcontractors located in about 20 states. The employees of the Commission number about 5,000. The contractors' employees engaged on work under contract for the Commission number about 40,000.

In considering how best to manage this strange and complicated business, the Commission has concluded that it should develop to the fullest possible extent, a plan of decentralized administration. For the small staff in Washington (which is not expected to number more than 400) are reserved responsibilities for policy determination, program direction and authorization, and general coordination of this far-flung enterprise. The Commission operates within the framework of the Government, and, while certain broad powers are given to the Commission under the statute, the entire operation must be conducted in conformity with a large number of Federal statutes, regulations, and requirements in terms of fiscal, personnel, safety, and other procedures. (*Continued on page 556*)

Address to the Graduates

Real Accomplishment and the Satisfaction of Living Result in a Democracy When Leaders Resolve Difficulties through Objective, Analytical Thinking

By Karl T. Compton

Farewell Address

As each one of you received his diploma this morning there came to you a feeling of satisfaction — an inner glow kindled by this final public and official seal of recognition on the successful completion of that period of your life toward which have been pointed the plans, hopes, and sacrifices of your families and yourselves ever since you passed from childhood to youth. Now you pass from youth to manhood, to a period of increased responsibility, which you can enter with independence, confidence, and opportunity because of the background of education symbolized by these diplomas. For all this, I congratulate you.

But I congratulate you also because you are going out to take your places in a world full of difficult problems within the country and vexed with international complications. Perhaps this calls for explanation. Should I not rather offer you my sympathies, instead of my congratulations, on the difficulties which you will face? Let me give two or three reasons for the more optimistic view.

My first reason is that the greatest satisfactions in life come from surmounting difficulties. If there were no difficult problems there could be little real achievement.

One of my professors in college kept a quotation written on an upper corner of the blackboard in his classroom. It read: "The pupose of a liberal arts education is not to help you earn your daily bread, but to make each mouthful sweeter." At the time I thought this was a fine and noble idea, but the longer I have lived, the more I have become convinced that this quotation told only a part of the truth. It missed entirely the fact that the greatest part of the pleasure which each mouthful gives is derived from the satisfaction in having successfully earned it — is derived in the work of getting it.

Your satisfaction in your degrees today would be far less if they had been acquired easily. The slogan "Tech is Hell" is a favorite with our Alumni because it reminds them of many long hours of strenuous work, and they take pride in the fact that they met the challenge and did the job. No athletic contest lives in the memories of participants or spectators unless it was a tough one which called for every ounce of strength and skill.

Permit me to give an example from a recent personal experience. No assignment which I was ever given gave me such dismay as the appointment last winter to the President's Advisory Commission on Universal Training, and I could imagine few jobs which I could have undertaken with less relish. It interrupted other work in which I was far more interested. It could not possibly lead to conclusions which would be universally accepted, like a scientific argument which can at the end be labeled "Q.E.D.", meaning that every intelligent person would, of necessity, have to accept the logic of the findings. I realized that whatever ideas I already had on the subject were not based on any exhaustive study or certain knowledge. I did not know most of my colleagues on the Commission, but knew that they had a very wide diversity of experience and viewpoint; and I wondered whether we could work together as a team or whether we would be disrupted by bickerings or preconceived opinions. I soon found that the other members of the Commission accepted the assignment with much these same reservations and misgivings. What happened?

Gradually the problem began to unfold before us as we studied one after another of its ramifications and as we attempted to gather, analyze, and evaluate the various facts and ideas submitted by thoughtful witnesses of wide diversity. From all this, our own various doubts and differences were gradually transformed into a conviction that a certain course ought to be pursued. Toward the end, when the picture began to take clear form in our minds, we began to feel a growing enthusiasm for the job; and when we finally handed the President our completed unanimous report and returned to our respective homes, it was with an intensity of relief and satisfaction that is impossible to express.

This episode illustrates, I think, how great may be the inner reward that comes from sustained effort to do a job, even though the job itself may have its disagreeable features. If, by good fortune, the job itself is in line with one's major interests, then the rewards are doubled. This should be true for most of you, as you now move into the various professional activities for which you have chosen to prepare yourselves. But whether you like any given assignment or not, do not forget that the greatest satisfactions in life come from the accomplishment of jobs that are not easy. Hence I congratulate you on the fact that you are graduating into a world full of problems.

Now let me approach the matter from a different angle.

Anthropologists tell us that the most virile and progressive peoples of the world are those who inhabit the temperate zone, and they offer an explanation. People living in the lush and lazy tropics find life too easy. With coconuts and breadfruit growing on the trees, with no need for protection against cold weather, there is no need for great ingenuity and perseverance to satisfy the primary requirement of keeping alive. Hence the attributes of ingenuity and persistent effort never become strongly developed. In the arctic regions, at the other extreme, life is so rigorous that every bit of vitality is used up in the struggle for survival.

In the tropics there is plenty of time which might be devoted to the so-called higher things of life, but the

traits of character prerequisite to such achievements have not been developed by force of necessity. In the arctic regions, on the contrary, there is ample necessity for developing rugged character, but no time and energy left over after having gained the bare necessities for existence.

In the temperate zones we have the happy medium. The seasonal variations of climate call for ingenuity, skill, planning, and consistent work to maintain the necessities of life on a year-round basis. But with these qualities developed and in operation, there are time and resources to permit continual, constructive accomplishment, first for raising the standards of physical existence, and then for the development of intellectual, cultural, and recreational interests. And thus, so the anthropoligsts believe, have the seasonal variations and the not too rigorous extremes of climate in the temperate zones induced the development of higher and more progressive types of civilization.

I suggest that we can advance an analogous argument regarding the effect of the economic and political climate. If we had what some would call an economic and political Utopia, with no problems and difficulties, with complete social security, no labor disputes, no political disagreements, no international rivalries, with everything running smoothly and under perfect control, then I wonder if we would not be living in the political tropics. We would lack the stimulus from difficulty, the hardening from struggle, and the occasional wholesome chastening from failure. We might well degenerate, and we might at least miss the satisfaction and even exaltation which come with successful struggle to achieve a desirable objective. I certainly would not say that we should not strive with all our power to achieve an economic and political life on this planet which is the most perfect which we can devise, but I do suspect that it is a good thing that we will never arrive at a situation in which difficult problems and opportunities for further improvement will not exist.

The major purpose of our education is to create the habits, implant the knowledge, and develop the skills which will insure objective and constructive performance.

In similar vein we can see a social analogue to the arctic climate. This would be an environment in which the rigors of economic distress and the buffeting by political forces are so severe that the average man has little hope or energy left after his exhausting struggle for bare survival. Such, unhappily, is the condition of many parts of the world today — those parts ravaged by war and helpless in the face of aggressive political minorities backed by force.

I believe that true democracy is the political analogue of the temperate zone. In democracy exist the differences of opinion and the continual play of economic and political problems which develop social conscience and encourage initiative for progress. A democracy will never be a static Utopia, nor will it be deadened by the rigors of dictatorship. It will have its cycles, like the seasons — business, in boom or recession; employment, up or down; inaugurating or discarding or patching up many a noble social experiment; Republicans or Democrats, Conservatives or Liberals in or out — and all the time people will be arguing about, and working for, improvements. Such is the invigorating climate of democracy, in which liberty and progress thrive. Just as we sometimes wish the winter were not so cold or the summer so hot, so do we often complain and even worry about the inconsistencies and apparent inefficiencies of democracy. Yet out of it all come power, achievement, and real satisfaction in living.

So, again for this reason, I congratulate you on going out to encounter serious problems on every hand.

In this connection I might remark that you have already lived through quite a variety of social climates, so you should be naturally adapted to these stimulating changes. I think you were all born during a Republican administration in our country, at a time when people wondered whether there could ever again be a political majority from any other party. But ever since you could read and write, our Chief Executive has been a Democrat. You were born in the prohibition era, but you have not seen much of it in practice. During your infancy our nation was drunk with illusions of permanent prosperity and universal wealth, and paper fortunes grew by the week. Then came the long period of world-wide depression, from which we in the United States were about the slowest to recover. Then, when prosperity seemed to be with us again at last, came World War II — and now the problems of reconversion to peace. Ten years ago our country was strongly isolationist, and every year college students staged peace strikes and many solemnly pledged themselves never, under any circumstances, to bear arms. Today our people are strongly convinced that we must never again stick our head, ostrichlike, into the international sand; and for the last six years every general public opinion poll has shown a sentiment, among those who express an opinion, of approximately three to one majority in favor of universal military training. In your childhood big business was the whipping boy blamed for our industrial ills. The Wagner Act and other acts were passed to curb big business and to build up a strongly competing labor union movement. (*Continued on page 552*)

Commencement of the United Nations

The Great Strides toward Peace, Made in Two Short Years by the United Nations, Require that the United States Be Prepared to Back Up Its Commitments

By Warren R. Austin

Commencement Address

THE power and the glory of M.I.T. are in the service it renders to mankind through its graduates. Therefore, I congratulate you upon the remarkable opportunity you have had to receive your education under the direction of a great leader in the promotion of human welfare and in the effort to reach the goal of freedom from war, coercion, and tyranny — Dr. Karl T. Compton.

Your distinguished president has rendered high service to this cause not only as president of this Institute, but as a citizen in the service of his Government. His leading part in the development of atomic energy and the organization of American science in support of the United Nations during World War II will long be remembered by his grateful fellow countrymen. He is continuing his service as consultant to the United States Mission to the United Nations in the negotiations we are pursuing toward the establishment of international control of atomic energy. I wish particularly to pay tribute to the work of the President's Advisory Commission on Universal Training, of which Dr. Compton is chairman. The report of that Commission will, I earnestly hope, help the Congress and the people to an understanding of the vital importance to the establishment of collective security, under the United Nations, of the maintenance by the United States of a strong military establishment founded on universal military training.

We must maintain our military establishment, not for purposes of domination, but in order to be able to back up our commitments in support of collective security under the United Nations. I know that every one of you realize that, if we were ever called upon to join in collective action against a major aggressor, we would not have the two years of grace we were given in the last war. We should have to act with decisive force at once and with men already trained.

Lasting peace is the earnest desire of all mankind. But lasting peace can be secured only as the end product of collective endeavors of many kinds, all directed toward building up a system of collective security. The building of such a system, in turn, depends upon the will and capacity of the member nations to support it with all their strength. There are no short cuts to peace. There is, above all, no way in which great nations like the United States and its individual citizens can evade the responsibilities, the sacrifices, and the burdens that must be carried if we are to establish and maintain a peaceful world order from which war is outlawed. The sacrifice of time during their education that would be required of the younger generation under peacetime universal military training would advance the cause of collective security and strengthen the chances of preventing another war which might easily be world-wide in scope.

Let us never forget that the United Nations is a means to an end. It is not the end. The mere existence of the United Nations and our participation in it does not establish collective security. The United Nations is a means by which collective security can be achieved.

Also, we must understand that every provision of the charter and every organ of the United Nations has a necessary place in the building of collective security. The work of the General Assembly and the Economic and Social Council, for example, are just as necessary to collective security as the work of the Security Council.

Reduction and removal of the basic causes of war by using the institutions of the United Nations to relieve political, economic, and social tensions and to raise standards of living is a most important element of collective security. Nor should we overlook the importance of such regional security arrangements as the Act of Chapultepec and the Inter-American system, for which the United Nations charter also makes provision.

The United Nations is at the very beginning of its work. It was only two years ago, on June 26, 1945, that the United Nations charter was signed at San Francisco.

During the brief time of your junior and senior years — only two out of the 16 years of your preparation for your careers — the United Nations has been in its preparatory period. Looking back we can see in true perspective the great progress we have been able to make in so short a time toward laying the foundations for building a system of collective security.

During this period the vast organizational structure of the United Nations has been largely completed. The General Assembly, the Security Council, the International Court of Justice, the Trusteeship Council, and the Economic and Social Council with its network of specialized agencies and commissions, are at work. Every day at Lake Success or at Geneva, or at some other regional center of United Nations activities, representatives of the member nations are meeting together to thrash out their differences and to seek and reach agreements for common action.

Political disputes, that might otherwise lead to war, are being debated and investigated instead by the Security Council. Dozens of projects, each of which is aimed at removing some of the basic causes of war, are under way. Let me mention only a few examples.

Secretary Marshall, in his commencement address last week at your great neighbor institution, Harvard University, spoke of the necessity of unified action for the restoration and reconstruction of the economy of Europe.

Only recently the United Nations established an Economic Commission for Europe which will help to make this possible. Every nation in Europe, including Soviet Russia, is a member of this Commission. So is the United States. This Commission is now organized and will meet again next month.

This week, at Lake Success, Mrs. Franklin Delano Roosevelt, chairman of the United Nations Commission on Human Rights, is meeting with fellow members to prepare a first draft of an international bill of human rights that can be submitted to the General Assembly and later to member governments for adoption.

At the same time progress is being made toward establishing a world law that can be enforced on both states and individuals. This week a General Assembly committee completed proposals for the codification of international law and for writing into that code individual liability to punishment for those who break the law against war or who attempt, as the Nazis did, to annihilate any racial or other group of human beings.

Another General Assembly committee left this week for Palestine to seek a United Nations answer for a problem that has defied solution for the past 25 years.

The Trusteeship Council and the trusteeship system and other provisions of the charter relating to dependent peoples are beginning to be used to advance non-self-governing peoples peacefully toward political freedom and higher standards of living.

All of these and many related developments are part of the process of building collective security. They are, in most cases, first steps on a long road. But they are, all of them, directed toward replacing economic conflict by economic co-operation, toward relieving social tensions by justice, toward substituting pacific means of settlement and judicial processes for anarchy and naked force in the relations between nations.

Atomic Energy for Peaceful Uses

Two of the most difficult as well as supremely important tasks in the establishment of collective security are the creation of an international system for the control of atomic energy that will assure its use for peaceful purposes only, and the elimination of weapons of major destruction including the regulation and reduction of all arms. Closely related with these is the conclusion of special agreements under which the Security Council will have at its call peace forces made available by member nations on a basis that will enable the Council to enforce the law against aggression in all parts of the world.

The present period of tension between the East and the West, and particularly between the United States and the Soviet Union, is delaying accomplishment of these tasks. Nevertheless, some progress has been made.

The Military Staff Committee has not secured unanimous agreement on some very important basic principles. But it is too often forgotten that we have in the Military Staff Committee something that the Great Powers did not have confidence enough in each other to establish even in the midst of a desperate war — that is, a permanent Combined Chiefs of Staff of all five of the Great Powers. They meet regularly together and they have succeeded in resolving many of the differences concerning the establishment of the peace forces required by the charter. The process of learning to understand each other and to achieve confidence in each other is a slow process, particularly in vital military matters, but it is working like a slow leaven here as elsewhere in the United Nations.

In the field of atomic energy, in which you, as future scientists and engineers, have a special interest, the Soviet Union continues to hold out against some of the essential principles for an international control plan originally proposed by the United States and accepted by all the members of the Atomic Energy Commission except the Soviet Union and Poland. Even so, the General Assembly resolution on disarmament of last December 14 marked progress. Unanimous agreement was secured for the first time on the general principle of a system of strict international control both of atomic energy and of other arms which would be established by separate treaties and would, in effect, become as integral a part of the constitutional structure of the United Nations as the charter itself.

Since then there has been little further progress toward agreement with the Soviet Union. Deputy Foreign Minister Gromyko's proposals this week will, I hope, prove to be a further step. The basic disagreements, however, remain. The Soviet Union continues opposed to the majority view on such essentials as the developmental and management functions of the proposed international atomic control agency, as well as on methods of enforcement. The Soviet Union rejects these functions apparently out of fear of capitalist "infiltration" inside Russia. Besides the other disagreements, the Soviet Union continues to call for separate and immediate outlawing of the bomb, instead of making prohibition of the bomb an integral part of the control system. This Soviet proposal, which has been repeatedly rejected by the other nations, would be unilateral disarmament of the United States and would provide no security either to ourselves or to the rest of the world.

Nevertheless, the Atomic Energy Commission is going ahead with the study of the specific proposals that will be necessary to implement the general principles upon which the majority are agreed. When these proposals have been worked out — with their explicit safeguards to each nation, explicit recommendations on the rights of the control agency, explicit opportunities for application to the International Court, to the Security Council or to other agencies of the United Nations for redress of inequities in the operation of the system — it is our hope that the Soviet Union will come to realize that there is no secret or hidden danger to the Soviet state in the proposed system of control. We hope she will also see that the limitations on the sovereignty of each member nation, that the majority believe are essential, can be so applied that they will not operate to the disadvantage of any one system of government or way of life, but on the contrary, will make it possible for each nation to join in the peaceful development of atomic energy without fear of violation of its independence or of destruction by some future atomic aggressor.

The United States, after all, asks nothing of the Soviet Union that we, ourselves, are not prepared to grant. We ask for strict international inspection and control; yet for a long time to come the United States would be the most inspected and the most controlled of all nations. We ask for a small surrender (*Continued on page 566*)

ALUMNI DAY—JUNE, 1947

Aviation—Today and Tomorrow

Anxiety for the Betterment of World Conditions Marks Alumni Day When 1,100 Return to Tech for Reunions

DETERMINATION to face international issues and to build up the nation's security through science and engineering became the theme of activities on Alumni Day, June 14, 1947. More than 1,000 attended the open-air luncheon, sheltered from the rain by tents erected in Du Pont Court; 500 were present at the symposium entitled "Aviation — Today and Tomorrow"; and 1,100 attended the banquet in the largest "pure alumni" gathering of its kind. In contrast with former years, an entire week, from June 7 to June 14, was devoted to activities of graduates and Alumni. These are treated in chronological order in the following columns.

Class Day exercises were held at Walker Memorial under the direction of Class and Senior Week officers: Norman N. Holland, Jr., President; Claude W. Brenner, Secretary-Treasurer; Kenneth A. Marshall, Donald M. Van Greenby, and Arthur Schwartz, Marshals; and Walter Kisluk, Beaver Orator.

As chairman of Senior Week, Kenneth A. Marshall welcomed the Alumni and guests; Walter Humphreys, '97, Secretary of the Corporation, gave the 50-year address; and, in a not-too-serious vein, Earl H. Eacker, '22, gave the graduates good advice from the 25-year Tech Alumni. Norman N. Holland, Jr., presented the gift of the Class of 1947 to Dr. Edward L. Moreland, '07, who accepted it gratefully on behalf of the Institute; and G. Kendall Parmalee, President of the Class of 1948, received the class ring from Mr. Holland. Walter Kisluk delivered the Beaver Oration.

In speaking for the 50-year Class, Walter Humphreys emphasized the rigor of mental discipline, which M.I.T. developed, with the words: "We are grateful for the emphasis put upon increasing our power through the rigid discipline of the Institute in our school days. Such a training as you have had should give you courage to undertake whatever vocation you are led to assume whether or not it is in the field of your recent professional career."

Having been admonished by Alumni Secretary, Charles E Locke, '96, not to give advice, Earl H. Eacker spoke generally in a light vein, although some of his remarks bore a serious aspect. Said Mr. Eacker: "I literally boil when I hear people say that government should do this or that for them. The citizens of this country, you and I, are the government. Let us fight to keep it so. There are many so-called political servants who would make us . . . believe we . . . want and are demanding that, through government, something special be done for us."

Application Approved

Following tradition in applying for admission to the Alumni Association, the Class of 1947 presented a skit portraying the difficulties which members of the Class had in obtaining positions in industry. During the discussion of their misfortunes at lunch in Walker Memorial, the students watch one of the Institute's janitors obviously displaying signs of affluence. Aroused to curiosity, the students learn that betting on horse races pays big dividends to the janitor who determines the names of the horses in each race which will win, place, and show, by the simple expedient of inserting the racing form in the differential analyzer. Pooling their meager resources, the boys urge the janitor to bet their money on a horse, and the janitor walks off with the comment that some people will believe anything provided it is wrapped up in an atmosphere of alleged science.

As a symbol of acceptance of the Class of 1947 into the M.I.T. Alumni Association, Harold Bugbee, '20, President of the Alumni Association, presented to Norman N. Holland, Jr., the '47 banner of the graduating class.

At the commencement exercises at Boston's Symphony Hall, Warren R. Austin (left), Chief of United States Mission to the United Nations, gave the commencement address, President Karl T. Compton addressed the graduates, and Dr. Sidney Lovett (right), Yale University Chaplain, delivered the invocation.

Taking part in Class Day activities at Walker Memorial on June 7 were (in usual order), Earl H. Eacker, '22, who delivered the address for the 25-year Class, Walter Humphreys, '97, Secretary of the Corporation, who represented the 50-year Class, and Harold Bugbee, '20, President of the M.I.T. Alumni Association.

The events of Class Day, during which the Class of 1947 was admitted into the Alumni Association, please officers of the Class about to be graduated. From left to right are: Claude W. Brenner, Secretary-Treasurer; Norman N. Holland, Jr., President; Walter Kisluk, Beaver Orator; and Kenneth A. Marshall, Chairman of Senior Week — all of the Class of 1947.

Commencement

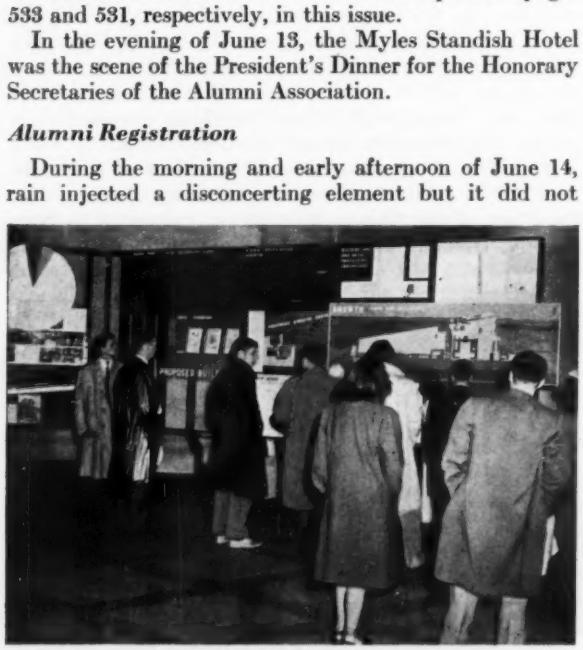
For the Class of 1947 the week's highlight occurred at Symphony Hall on June 13 when 763 students received a total of 765 degrees from the Institute. Conferred were 53 doctor's, 225 master's, and 487 bachelor's degrees. Among those who received diplomas were 10 young women.

Dr. Sidney Lovett, Chaplain of Yale University, made the invocation, Warren R. Austin, Chief of the United States Mission to the United Nations, delivered the commencement address, and in bidding farewell to the Class of 1947 as students, President Compton welcomed them as Alumni. The Review is pleased to be able to publish the addresses of Mr. Austin and Dr. Compton on pages 533 and 531, respectively, in this issue.

In the evening of June 13, the Myles Standish Hotel was the scene of the President's Dinner for the Honorary Secretaries of the Alumni Association.

Alumni Registration

During the morning and early afternoon of June 14, rain injected a disconcerting element but it did not dampen the spirits of more than 1,000 who returned to the Institute to meet old friends and Faculty, to inspect the laboratories and educational exhibits on display in the lobby of Building Seven, and to enjoy themselves as "old grads."



Educational exhibits in the lobby of Building 7 greeted Alumni on their return to the Institute and portrayed in pictorial and interesting manner the growth, present activities, and anticipated expansion of the Institute. Shown here is the section illustrating proposed new buildings for which funds are now being raised.

To Admiral Luis de Florez, '11, and his son, Peter, of the Class of 1938, goes the credit of making the most spectacular return to Technology when the Admiral's Navy plane, painted in cardinal and gray with the '11 numerals on it, landed in the Charles River Basin to be met by motor patrol. To Keith W. Robbins, '22, of Korea, goes the credit of having traveled the longest distance to attend Alumni Day. To C. Frank Allen, '72, was given a rousing cheer at the banquet in honor of his 75th year as an M.I.T. alumnus. Finally, but in no sense least, to Charles E Locke, '96, goes the credit for addressing the banquet by telephone from the cool, comfortable Homberg Infirmary where the Alumni Secretary is rapidly recuperating from a recent operation.

Du Pont Memorial

At noon, the Du Pont Memorial Room was dedicated in the Guggenheim Aeronautical Laboratory. In appropriate words, Professor Jerome C. Hunsaker, '12, recalled the active work of Richard Chichester du Pont as the country's leading expert in gliders and the meteorological problems associated with motorless flight, and stated that the room being dedicated would be used for the recreation of students and guests in aeronautical engineering, as well as for symposia in aeronautical science and related subjects.

The memorial gift was formalized with a few brief remarks by Mr. A. Felix du Pont, Jr., for whose brother the room has been named. Mrs. M. Chichester du Pont, mother of the late airman, was also present. We recall here merely the formal ceremonies which took place on Alumni Day. A more detailed account of the Du Pont Room, and the postdoctorate fellowships established by gift of the Du Pont family, will be found in the Institute Gazette, page 543.

Open-air Luncheon

Whereas the majority of more than 1,000 persons balanced plates in the buffet-style luncheon under the protection of two large circus tents in Du Pont Court, rooms in Building One were reserved for the 25- and 50-year Classes. In traditional manner, President Compton attended luncheon with the Class of 1897, but also took opportunity to speak with members of the luncheon gathering of the 25-year Class, who greeted him enthusiastically, as well as with representatives of many other classes.

Aviation — Today and Tomorrow

By 2.30 P.M. the weather had cleared, and more than 500 persons attended the symposium on "Aviation — Today and Tomorrow" held at Morss Hall of Walker Memorial. As symposium chairman, Professor Jerome C. Hunsaker introduced the speakers: General George C. Kenney, '11, Commander, Strategic Air Forces; Arthur E. Raymond, '21, Vice-president, Douglas Aircraft Corporation; and John C. Leslie, '28, Vice-president, Pan American World Airways. The Review is pleased to publish the symposium addresses in full elsewhere in this issue.

Wind Tunnel

Following the symposium, "open house" was held in the President's Garden and, simultaneously, ground was broken for a supersonic wind tunnel of advanced design, on ground west of Massachusetts Avenue. The new tunnel, financed by the Bureau of Ordnance of the Navy Department for use in a research and development program sponsored by the Bureau of Ordnance, will be used to test aircraft and missile models at speeds ranging from 1,000 to 3,000 miles per hour.

Representatives of the United States Navy, members of the Institute's Administration, and guests attending the ground-breaking ceremonies included: Vice-Admiral George F. Hussey, Jr., Chief of the Bureau of Ordnance; Rear Admiral Daniel V. Gallery, Assistant Chief of Naval Operations for Guided Missiles; Rear Admiral A. M. Pride, Chief, Bureau of Aeronautics; General George C. Kenney, '11, Commander, Strategic Air Forces; President Karl T. Compton; Vice-president James R. Killian, Jr., '26; Dr. Carroll L. Wilson, '32, General Manager of the Atomic Energy Commission; Arthur E. Raymond, '21, Vice-president of the Douglas Aircraft Corporation; John C. Leslie, '28, Vice-president of Pan American World Airways; Dr. Jerome C. Hunsaker, '12, Head of the Departments of Mechanical and Aeronautical Engineering, and Professor John R. Markham, '18, Department of Aeronautical Engineering, who now directs research at the Wright Brothers Wind Tunnel.

Stein-on-the-Table Banquet

As has been the custom for many years, the Statler Hotel was the scene of the Alumni Day Banquet, for which more than 1,000 Alumni gathered in the Imperial Ballroom at 7:00 P.M.

After the banquet courses were finished and the Alumni were well into the process of initiating the new 1947 steins, Harold Bugbee introduced the honored guests at the head table. Missing from the rostrum for the first time in many years was Professor Charles E Locke, but telephone connections and a public address system enabled the Alumni Secretary to address the group in a 15-minute speech.

Following these introductions, Carroll L. Wilson spoke on "Problems of Management in the Atomic Energy Commission," which is presented in full, beginning on page 529 of this issue.

Following this formal address, Albert J. Browning, '22, presented a gift of $27,000 to the Institute from his Class, and John P. Ilsley, '97, transferred a check for $34,000 as a gift of the 50-year Class.

Francis J. Chesterman, '05, chairman of the Alumni Fund Board, announced that the Board had recently voted to make available to the Corporation, as a gift from the Alumni, $500,000 to be used in the construction of a new Senior House to be erected on land now owned by the Institute west of Massachusetts Avenue.

In his reponse of acceptance, Dr. Compton stated that the Senior House was urgently needed and that it was anticipated that construction on the new housing unit will be well under way in another year. Following acceptance of this gift from the Alumni, President Compton presented his annual report to the Alumni, entitled "Retooling for Peace" and reproduced herewith.

In memory of Richard Chichester du Pont, postdoctoral scholarships in meteorology were established and a recreational room for students in aeronautical engineering was dedicated on Alumni Day. Present at the dedication were Mrs. M. Chichester du Pont, A. Felix du Pont, Jr., who made the presentation on behalf of his brother for whom the room is named, and Dr. Compton.

Retooling for Peace

Retooling for peace at the Institute has not been without its headaches. At the same time, the transition has offered opportunities and challenges which have been met with enthusiasm and vigor by our entire Administration and Faculty, and by you Alumni.

I want to report briefly tonight on some of the highlights of the last year and to give you some of the underlying reasons for the changes that have been made and are contemplated. Let me say at the outset, however, that the basic objectives of M.I.T. are the same today as they were in your student days and as they were when William Barton Rogers brought this institution into being.

Technology has grown not only in size, but in general stature and reputation. The factor of size alone has brought us to a critical analysis of some of our problems. As a result we have taken a careful long-term view of such things as the allocation of space, the proper relationship between sponsored research and the rest of the educational program, our nonacademic relations with students, and our whole financial structure, among others. I have reported to you in some detail on some of these studies, and now I want to mention those which have received closest attention in the year just ending.

Principals in the Symposium were: General George C. Kenney, '11, Commander, Strategic Air Forces; Professor Jerome C. Hunsaker, '12, Symposium Chairman; Arthur E. Raymond, '21, Vice-president, Douglas Aircraft Corporation; and John C. Leslie, '28, Vice-president, Pan American World Airways.

Ready to partake of another Stein-on-the-Table Banquet were honored guests from many classes. In reading order may be seen Earl H. Eacker, '22, 25-year speaker at Class Day exercises; John J. Rowlands (in process of arranging for photographs for newspapermen); Raymond H. Blanchard, '17, President-elect of the Alumni Association; William W. Garth, '36, Chairman of Banquet Committee; Albert J. Browning, '22, who presented the gift from the 25-year Class; Rear Admiral Daniel V. Gallery, who took part in wind tunnel ceremonies; Francis J. Chesterman, '05, who announced $500,000 alumni gift to complete construction of Senior House; and Arthur E. Raymond, '21, symposium speaker.

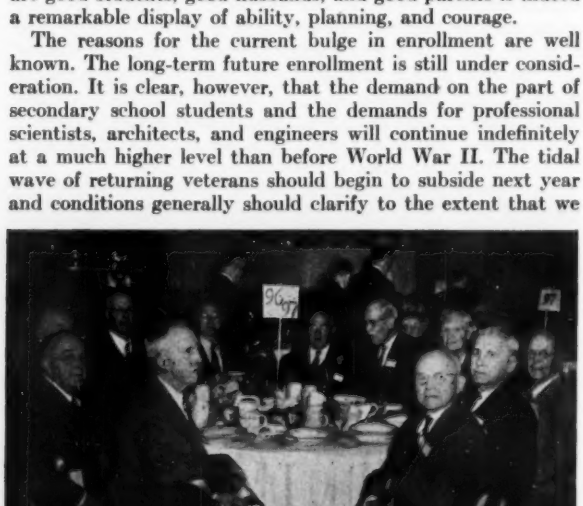
The student enrollment has reached an all-time high of 5,250. We had expected that it would rise to 4,500; the assimilation of the additional 750 was not easy but it has been done most effectively through the tireless efforts of the entire staff. The present figure of 5,250 represents an increase of more than 70 per cent above the prewar stabilized enrollment. To give you a measure of the growth of the Institute during the last 50 years, I will recall for you that the total registration was approximately 1,200 in 1897; 3,500 in 1922; and 3,000 in 1942.

Student Body

But what of the student body of 1947? Academically they are significantly better than the prewar group despite the fact that the majority of them have been absent for periods ranging from two to four years. The ill effects of this interruption in their schooling have been more than offset by the added maturity and the determination to get through and get started on their professional careers. About 25 per cent of our students are married; many have children.

Despite the financial help many of these men are getting from the government, the fact that so many of our students are good students, good husbands, and good parents is indeed a remarkable display of ability, planning, and courage.

The reasons for the current bulge in enrollment are well known. The long-term future enrollment is still under consideration. It is clear, however, that the demand on the part of secondary school students and the demands for professional scientists, architects, and engineers will continue indefinitely at a much higher level than before World War II. The tidal wave of returning veterans should begin to subside next year and conditions generally should clarify to the extent that we can estimate more realistically for the future. Of considerable significance, however, is the fact that applications for admission from secondary schools are now more than double the number we received in 1941.



Enjoying more than half a century of life as Technology graduates are (clockwise, from center opening): Henry G. Grush, '96; Robert A. Davis, '96; Perry B. Howard, '96; Francis C. Hersey, '96; James M. Driscoll, '96; Frederick W. Damon, '96; John A. Rockwell, '96; Samuel P. Hunt, '95; Conrad H. Young, '96; Luther K. Yoder, '95; and Edwin C. Alden, '95.

Where, and under what conditions, are all of our students living? The housing situation in the Boston area is no better than in any other large metropolitan center, yet we can say with some pride that no student has as yet had to sleep on a park bench. Through the ingenuity of Professor Leicester F. Hamilton, '14, Mr. Wallace M. Ross, General Secretary of the Technology Christian Association, the Housing Bureau, the fraternities, and the generosity of many of our staff in making rooms available, the housing problem has been kept under reasonable control. The quarters of some students, both single and married, are still far from satisfactory, however, and the problem remains one to which we shall have to give our continued efforts. The construction of the new Senior Dormitory will greatly alleviate the situation, but under the best of conditions we cannot hope to have it ready for occupancy before the fall of 1948.

In addition to our regular dormitories and Graduate House, we have provided this year for 500 single students in a converted wartime temporary research building. One hundred married students are living in Westgate, which was built entirely by the Institute at an expense of $500,000 (which should be recoverable), and 170 married veterans in Westgate West. Despite the fact that the buildings and the erection of Westgate West were at government expense, the Institute had to spend more than $150,000 (which cannot be recovered) for site work and services.

The Faculty Today

In speaking before The Technology Club of New York, two years ago, Horace S. Ford, Treasurer, very forcefully demonstrated that it is personalities that make a truly great institution. What of our Faculty today? In professional competence, enthusiasm, and morale, the staff of your school is second to none in the world. Considering the fact that many of the staff had scarcely time to catch their second breath between the end of a hectic and heavy war research assignment and the beginning of an excessively heavy teaching and research load last fall, I consider their accomplishments remarkable.

From time to time I have called attention to the fact that the salary level at the Institute needed prompt attention. The adoption of the annual salary plan two years ago helped to increase the guaranteed take-home pay of the staff, particularly the younger staff. As a further step, we increased all staff salaries last fall, retroactive to July 1, by 10 per cent with a ceiling of $600. In comparison with salary averages in other educational institutions, we are holding our own but are not yet in the position of leadership that we should be, considering the fine quality of our staff.

For many years Technology has taken pride in co-operating with the United States armed services in educating officer

The right-hand half of the speakers' table included (in usual order): Harold Bugbee, '20, President of the Alumni Association; Carroll L. Wilson, '32, banquet speaker; General George C. Kenney, '11, symposium speaker; H. E. Lobdell, '17, Executive Vice-president of the Alumni Association; Vice-Admiral George F. Hussey, Jr., who broke ground for the wind tunnel; Jerome C. Hunsaker, '12, Chairman of the Symposium; John P. Ilsley, '97, who presented the gift from the 50-year Class; Walter Humphreys, '97, 50-year speaker at Class Day; John C. Leslie, '28, symposium speaker; Norman N. Holland, Jr., President of the Class of 1947; and Parke D. Appel, '22, General Chairman of Alumni Day.

personnel in specialized fields of engineering and science. This is particularly true in fields in which our staff and facilities are unique, such as Naval Construction and Instrumentation. As a further step in the co-operation we are accepting a few of the young West Point instructors who come to Cambridge to observe the teaching techniques and to refresh their knowledge of some of the professional courses they will teach at West Point. Yet if we had admitted in the last year all the qualified officers the services wanted to assign here for work in aeronautical engineering, we would not have been able to accept a single civilian student in that course. Appreciating that we have obligations to educate men for industrial posts, we have had to impose limitations on the number of military personnel we can accept in certain of the already overcrowded courses.

The sudden and large increase in student enrollment, as well as the variety of student background, has resulted in a need for closer organized liaison between Faculty and students. Dr. Everett M. Baker, our new Dean of Students, has undertaken to expand our whole system of student counseling. Before World War II, our corps of registration officers, working with the Dean's Office, was reasonably adequate to meet the needs of the students. Dean Thomas P. Pitré, Joseph C. MacKinnon, '13, Registrar, and Dr. Dana L. Farnsworth, the new Director of the Medical Department, and all of the registration officers are co-operating with Dean Baker to bring about a more personal relationship between staff and students.

In my report to the Corporation last fall, I mentioned that suggestions had come from the Faculty and Administration that the time was ripe to stand off and consider our educational objectives. The Committee on Educational Survey, headed by Professor Warren K. Lewis, '05, was appointed by the Faculty last winter and has already made great headway in a re-examination of many of the procedures and practices covering many phases of our activity. Funds have been made available to study and analyze practices in other institutions. The committee has sent memoranda to the Faculty periodically, inviting suggestions and comments. The whole Faculty have thereby become consultants to the committee. The amount of discussion that these memoranda have aroused among the staff is good evidence that the final conclusions of the committee will draw heavily on the wealth of faculty experience, will be representative of faculty thinking, and will have an invigorating effect on our whole program.

Student Activity

The Corporation Committee on Student Activity, under the chairmanship of Donald F. Carpenter, '22, has been very active in promoting the enrichment of student life.* Of the many questions the committee has examined, two stand out as major contributions to the welfare of students. First was recognition for a well co-ordinated living and playing area on the Institute campus. As a result of their recommendations, the area west of Massachusetts Avenue has been planned to permit the greatest usefulness of our limited space for athletics and future housing. Second, was recognition that student government under present conditions needed guidance. The fact that the student body was bound to be heterogeneous, as a result of so many students leaving and returning at various levels and a lack of continuity in the several class offices, put a severe burden on the top student leaders last fall. All of us have wanted to retain the advantage of student responsibility and leadership in student affairs, for which Technology has long been recognized. The Corporation Committee on Student Activity set up a subcommittee, with Marshall B. Dalton, '15, as chairman, to help the student leaders with their many problems. This committee has worked closely with the Administration and has been so successful in giving a lift to student government without impairing the independence of student management that, on recommendation of Chairman Carpenter, a permanent Advisory Council has now been set up under the Alumni Association.

Athletics is the largest of our extracurricular activities. The Alumni Advisory Council on Athletics, of which Ralph T. Jope, '28, has long been secretary and has served so ably as liaison between the Administration and students, concluded a year ago that a permanently larger student body demanded the full time of a competent director of athletics. As a result, we have just appointed Mr. Ivan J. Geiger to the new post. Mr. Geiger's many years of experience in college athletics provides an ideal background for the type of full-time leadership we need. Again, we shall continue to encourage students to take full responsibility for their extracurricular affairs and we are convinced that this can be done to an even greater extent with a full-time director.

At the banquet, the Faculty was represented (in clockwise order) by: Thomas P. Pitré; Ronald H. Robnett; Delbert L. Rhind; Carl M. F. Peterson, '29; Nicholas A. Milas; James W. F. MacDonald who was honored by the award of honorary membership in the Alumni Association; Frederick G. Hartwell; Walter C. Voss, '32; Antoine M. Gaudin, and Dean Everett M. Baker.

* Report of this Committee will be found on page 544.

Below in clockwise order from left are: R. E. Schmidt, '87; Franklin Brett, '87; N P. A. Carter, '87; B. C. Batcheller, '86; Mildred Allen, '22; C. F. Allen, '72, celebrating 75 years as Tech alumnus; G. W. Kittredge, '77; S. S. Dearborn, '84; J. A. Cameron, '87; O. E. Nutter, '87; Lonsdale Green, '87; and A. T. Chase, '86, shaking hands with Dr. Compton.

More than 200 members of the Class of 1922 attended the Alumni Banquet. At one of the tables the photographer snapped (in clockwise order from the left): Laurence E. Barstow, '23; Roland L. Smith, '22; W. Raymond Hewes, '22; Lloyd E. Raymond, '22; Clarence W. Perkins, '22; Adolph B. Alland, '22; Theodore T. Miller, '22; Harold C. Wagner, '22; Arthur B. Craig, '22; and Allan H. Kidder, '22.

Research

The volume of our sponsored research has been reduced intentionally to a point where the proportion of time and energy given to such research is consistent with our primary objective, the education of men. We have adhered to the principles that sponsored research should be of a type that advances knowledge, presents a challenge to our staff and will be undertaken enthusiastically, and that the bulk of it be unclassified.

As you well know, we concentrated all of our efforts during the war on research and training with but one objective in mind, to win the war as quickly as possible. As a matter of considered policy, all of the research was carried out on a "no profit–no loss" basis. We have just concluded the final settlement with the Office of Scientific Research and Development, which sponsored 85 per cent of our war research, and I can now report that we received for overhead on our O.S.R.D. contracts a total in the six years of operations of 2.85 per cent of the total dollar volume to cover indirect expenses, such as administration, heat, light, power, and the use of our academic plant and equipment. This amounts in dollars to slightly more than we received in gifts and grants in the one year 1945–46! Any comparison with similar figures for industrial operation adds emphasis to the real meaning of "no profit–no loss" and to the philosophy that M.I.T. is dedicated to the public service. In services freely given the government without compensation, we estimate that the Institute contributed about one million dollars worth of services, without reimbursement.

As a part of our expansion for war research we greatly increased our available academic space. Two facts should be kept well in mind in this connection: first, a great deal of the added space was of temporary construction, expensive to maintain and of no permanent lasting value to our purposes; second, of the cost of the permanent buildings constructed during the war, the government paid only what it would have cost to erect temporary structures. M.I.T. provided the balance.

In mentioning our wartime research policies, I do not want to imply that we are in the least regretful of our decisions. The cause was so important that we would take the same steps today that we have taken in the last seven years. Rather, I want you to understand that M.I.T. did not make money during the war; expansion has added significantly to our maintenance costs.

The added space, however, represents only a part of our financial problems. A survey by the American Council on Education shows that since 1940, operating costs in colleges have risen 52 per cent, that half of the increase is due to heavy veteran enrollment, that it costs 10 to 15 per cent more to educate the G.I. than other students because of the red tape involved. These figures are indicative of the situation throughout the country and apply with even greater force to M.I.T., since the expenses of operating a technical institution are always greater than those of the liberal arts type.

Finances

It follows without any demonstration that no nonprofit institution can operate on a $14,000,000 scale with the help of an endowment geared to a $3,500,000 level. This is precisely the position we are in today.

Our frank appraisal of our present status leads us to the conclusion that we must seek a total of $28,000,000 to carry on even frugally the job that must be done. The basic needs include facilities in the war-born fields of science and engineering, such as electronics and nuclear science and engineering, as well as other facilities necessary to the health, welfare, and both the cultural and technical education of our youth. These needs have been set forth in a brochure, a copy of which has just been sent to the Alumni. As a member of the Institute family I know you will be interested in becoming better acquainted with the plans we have made for rendering more effective service in the years ahead.

Of the total needs of $28,000,000, we have already received or have pledges for $8,000,000. This is indeed a good start toward our ultimate goal. During the last year, we have received in gifts and grants a total of $2,234,000, of which $396,000 came from industrial companies, $1,262,000 from foundations, and $576,000 from individuals. In addition, we have received during the year assurances of future gifts totaling $813,000.

The welfare and security of the United States are closely related to the welfare and security of our educational institutions. A vigorous and flourishing educational system is our best assurance of continued prosperity and intelligent alertness.

In conclusion, I will say that retooling for peace has been as exciting as it has been difficult. We look to the future with enthusiasm, and with the full confidence that we have your hearty support.

THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

Election Returns!

IN concluding an active year of alumni progress, reports of officers, committees, and advisory councils constituted the major portion of the 257th meeting of the Alumni Council which was held in the Campus Room of the Graduate House on May 26.

President Bugbee presided at the meeting attended by 93 members and guests, including Raymond H. Blanchard, '17, and John A. Lunn, '17, recently elected president and vice-president, respectively, of the M.I.T. Alumni Association.

The results of the annual ballot counting showed that the following had been elected: President, for one year, Raymond H. Blanchard, '17; Vice-president, for two years, John A. Lunn, '17; Executive Committee, for two years, Horatio L. Bond, '23, and Dwight C. Arnold, '27; Term Members of the Corporation, for five years, James McGowan, Jr., '08, Harold Bugbee, '20, C. George Dandrow '22. The following members of the National Nominating Committee were also elected: *District 8*, Jonathan A. Noyes, '12; *District 9*, Stephen L. MacDonald, '39; *District 10*, Dr. Henry C. Gunning, '26.

At the meeting of the Executive Committee earlier in the day, James W. F. MacDonald had been elected a new honorary member and H. E. Lobdell, '17, Charles E Locke, '96, and Ralph T. Jope,'28, had been re-elected officers of the Alumni Association for the coming year.

Upon conclusion of reports rendered by committee and advisory council chairmen, President Bugbee introduced President Compton who told the Council of the desire, on the part of the Corporation and the Administration, to provide new athletic facilities as soon as funds for this purpose could be obtained.

President Bugbee then introduced Dr. Everett M. Baker, Dean of Students, whose address was entitled "A Dean's Hopes for the Future." In order to develop a community of interest and thought among the students, Dean Baker hoped that in the future more dormitories would be built and that all freshmen could be imbued with the desirability of developing a greater consciousness for community spirit and co-operation as a training for the student's later life. Dean Baker expressed the hope that it would ultimately be possible for the Institute's students to live together in a Technology community near M.I.T. Since plans for additional housing units are scheduled for construction along Memorial Drive between Massachusetts Avenue and the Cottage Farm Bridge, this area would appear to be most desirable for the development of such a community. With a major portion of the student body living together during their years of study, Dean Baker held forth the hope that a properly stimulated community life would provide for cultural development which cannot be achieved under present conditions. As a means for increasing interest in extracurricular activities, members of the Faculty who were proficient in some hobby or sports, were encouraged to devote time, after class, to directing or stimulating extracurricular student activities.

Breaking ground for the Institute's new wind tunnel is Vice-Admiral George F. Hussey, Jr., while in good-natured repose are standing (left to right): John R. Markham, '18, Professor of Aeronautical Engineering; Jerome C. Hunsaker, '12, Head of the Departments of Aeronautical and Mechanical Engineering; Rear Admiral Daniel V. Gallery, and Rear Admiral A. M. Pride.

Clark S. Robinson, 1888–1947

CLARK S. ROBINSON, Associate Professor of Chemical Engineering, who attained eminence for his research and publications in the field of distillation, died on Friday, May 23.

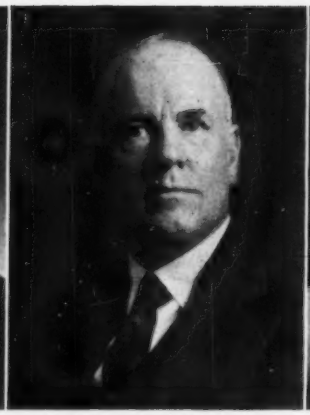
Born on April 8, 1888, in Fall River, Mass., Professor Robinson was graduated from the Institute with the degree of bachelor of science in 1909 and was awarded his master's degree in 1915. He joined the instructing staff in 1916 and was made an assistant professor of industrial chemistry in 1919. He was appointed associate professor of chemical engineering in 1925.

During World War II, Professor Robinson held the rank of colonel in the Ordnance Department and was active in the safety and security division of the Ordnance Department and the Army-Navy Explosives Safety Board. Notable improvements in the manufacturing and handling of explosives in wartime and the great reduction in accidents from explosions and fires associated with high explosives were due in large degree to the effective measures established by these organizations.

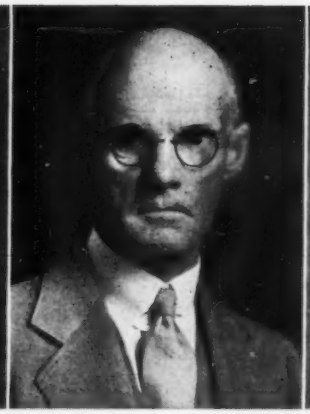
Professor Robinson's chief activity in this connection was organization of the work of these agencies on a scientific basis. While World War I was notorious for many accidental and planned fires and explosions, World War II had within the continental United States relatively few disasters of an accidental type and none due to sabotage.

Professor Robinson spent most of his time during the war at the Signal Laboratory at Fort Monmouth, N. J., and in Washington, and for his contributions to safety he was awarded the Legion of Merit.

LYMAN M. DAWES, '23
Assistant Professor of Industrial Applications



ARTHUR B. ENGLISH
Technical Instructor in Mechanical Engineering



ARTHUR L. GOODRICH, '98
Associate Professor of Drawing and Descriptive Geometry

WALDO V. LYON, '05
Professor of Electrical Machinery

Emeriti

THE retirement of eight members of the teaching staff, who have taught at the Institute for many years, has been announced by Dr. Compton. Those members of the staff who will retire on July 1 are: Professor Henry B. Phillips, Head of the Department of Mathematics; William N. Seaver, the Institute's Librarian; Henry L. Seaver, Professor of History in the School of Architecture and Planning; Professors William H. Timbie, Waldo V. Lyon, '05, and Lyman M. Dawes, '23, all of the Department of Electrical Engineering; Associate Professor Arthur L. Goodrich, '98, of the Section of Graphics; and Technical Instructor Arthur B. English of the Department of Mechanical Engineering.

Professor Phillips, who is to be succeeded as head of the Department of Mathematics by Dr. William T. Martin, joined the M.I.T. Faculty as an instructor in 1907. Professor Phillips was graduated from Erskine College in 1900, and then carried on graduate work at Johns Hopkins University, which awarded him the degree of doctor of philosophy in 1905. His teaching career began at the University of Cincinnati, where he was an instructor in mathematics from 1905 until he joined the staff of the Institute. Professor Phillips became a full professor in 1927 and in 1934 he was appointed acting head of his Department and became its head a year later. He has also been a consulting professor of physics at Brown University and a lecturer at the University of California. During World War I Professor Phillips took special training at the Coast Artillery School at Fort Monroe, Va., and later carried on scientific work at the Naval Experimental Station at New London, Conn. He is the author of more than 20 books and scientific papers, chief among which are "Notes on Einstein's Theory of Gravitation," "Faraday's Law as a Basis of Electromagnetic Theory," and a text on *Vector Analysis*.

William N. Seaver joined the library staff of the Institute in 1925 as an assistant to Robert P. Bigelow, then librarian, and in the same year succeeded Professor Bigelow as head of the library. Mr. Seaver was educated at Millbury High School and Worcester Academy and was graduated from Harvard University in 1900. He joined the staff of the New York Public Library in 1910 after several years of experience in the publishing business, and in 1914 he joined the Municipal Reference Library, a special branch established for the use of New York City employees. In 1919 he was a delegate for the Library War Service of the American Library Association at Edgewood Arsenal, later transferring to Newport News where he had charge of the collection of books and periodicals for servicemen overseas. Before joining the Institute's library, Mr. Seaver had been librarian of the Woburn Public Library from 1920 to 1924.

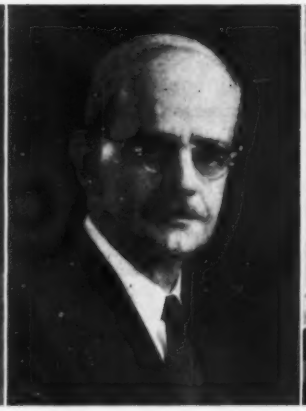
Professor Henry L. Seaver has been a member of the Institute's teaching staff since 1901 and until 1933 he was on the staff of the Department of English and History. In 1907 he became an assistant professor, and an associate professor in 1916, rising to the rank of full professor in 1929. In recent years he has been a member of the Faculty in the School of Architecture and Planning, specializing in courses in the history of painting and European civilization and art. Professor Seaver was graduated from Harvard University in 1900, and in 1914 he completed graduate work for the degree of master of arts. He has been associated for many years with the Boston Museum of Fine Arts and is widely known as an authority on typography, woodcuts, and photography. He is the author of *The Great Revolt in Castile*, a history of medieval Spain, and has contributed numerous papers to various journals in the fields of his interest.

Professor Timbie joined the Institute's staff in 1919 after several years of experience in electrical engineering instruction at the Pratt Institute in Brooklyn, N. Y., and at Wentworth Institute in Boston where he was head of the department of applied science. He is widely known as an educator in the field of electrical engineering and is the author of several books on electrical subjects which are recognized as standard texts in many schools and colleges. The Electrical Engineering Co-operative Course was established largely through his efforts and he has been in charge of the Co-operative Courses at the Institute for many years. Professor Timbie was graduated from Williams College in 1901.

Professor Lyon is widely known for his studies of alternating current machinery, properties of conductors, and other electrical problems involving mathematical analysis. He joined the Institute's staff as an assistant in electrical engineering upon his graduation from M.I.T. in 1905. Two years later he was made an instructor and was

HENRY B. PHILLIPS
Head of the Department of Mathematics

HENRY L. SEAVER
Professor of History



WILLIAM N. SEAVER
Librarian of the Institute

WILLIAM H. TIMBIE
Professor of Electrical Engineering and Industrial Practice

advanced to the rank of assistant professor in 1916, and to professor of electrical machinery in 1929. He is a fellow of the American Institute of Electrical Engineers, and has written numerous technical articles on subjects on which he is recognized as an authority. He is the author of *Problems in Electrical Engineering*, *Problems in Alternating Current Machinery*, and *Applications of a Method of Symmetrical Components*.

Professor Goodrich was graduated from M.I.T. in 1898 and has been associated with the Institute staff since 1902 when he was appointed an assistant in mechanical drawing. In 1905 he became an instructor in drawing and descriptive geometry and was an assistant professor from 1917 to 1926, when he was promoted to the rank of associate professor. Since 1939 he has been a member of the staff of the Section of Graphics.

Professor Dawes joined the staff of the Institute as an assistant in 1922 while he was still a student and received his degree from the Institute in 1923. He was a research assistant from 1924 to 1925, when he became an instructor in electrical engineering, serving until 1941 when he was made assistant professor of industrial applications.

Mr. English, technical instructor in mechanical engineering, became an assistant on the Institute's staff in 1907 in the Department of Electrical Engineering. He served as an assistant in machine tool instruction until 1917, and as instructor in the same field until 1920, when he was made an instructor in mechanical engineering with faculty rank. He became a technical instructor in 1941.

Du Pont Fellowship in Meteorology

THE memory of Richard Chichester du Pont, who until his death in 1943 was one of the country's leading experts on gliders and the meteorological problems associated with motorless flight, has been perpetuated in a memorial established at the Institute.

The memorial, made possible by a gift of $110,000 from members of Mr. Du Pont's immediate family, endows a postdoctorate fellowship in meteorology; it will also provide a memorial room in the Guggenheim Aeronautical Laboratory for the use of students in aeronautical engineering and related fields. By enabling outstanding students to continue advanced study and research after completing their work for the doctor's degree, the fellowship will contribute directly to the advancement of the aeronautical sciences. The Du Pont Memorial Room provides a much needed place for students to come together for social and professional objectives under dignified and attractive conditions.

At the time of his death during a glider test for the Army Air Forces at March Field, Calif., on September 11, 1943, Mr. Du Pont, who was 32 years old, had achieved wide recognition for his contributions to the art of gliding. In the powered-plane field he had pioneered in the pickup air-mail service, which was inaugurated in 1939 by his company, All American Aviation, Inc., for 115 cities and towns in the East where no airport facilities existed.

Members of the family who have established the memorial at M.I.T. include Mr. Du Pont's father, A. Felix du Pont of Wilmington, Del.; his mother, Mrs. Chichester du Pont; his widow, Allaire C. du Pont; his brother, A. Felix du Pont, Jr.; his sisters, Mrs. James P. Mills and Miss Lydia C. du Pont; Irenee du Pont, '97; and Henry B. du Pont, '23.

For his notable contributions to the glider program of the Army Air Forces during World War II, both in this country and abroad, Richard Chichester du Pont received many posthumous honors. On December 20, 1943, he was awarded the Distinguished Service Medal by General Henry H. Arnold "for exceptional professional ability and inspiring leadership in planning and supervising the effective utilization of military gliders and related equipment"; on April 19, 1944, the John Price Wetherill Medal of the Franklin Institute; and on November 15, 1944, the Evans Glider Trophy of the Army Air Forces "for the greatest individual contribution to glider development in 1943."

Mr. Du Pont was the holder of numerous American glider records in the middle 1930's and was national soaring champion several times. While competing in the national soaring events at Elmira, N. Y., in 1937, he won the $1,500 silver Evans Trophy. Convinced that the art of glider flying — soaring through the air without motive power — was the most fascinating of all sports, he was one of the first to foresee commercial and military applications for gliders. He was president of the Soaring Society of America in 1938, was a director of the Institute of Aeronautical Sciences, and president of All American Aviation, Inc. from 1938 until his death.

Flight Research

APPOINTMENT of Dr. Edwin G. Schneider to be director of a comprehensive program of research on controlled flight, including flight at supersonic speeds, was announced on June 3 by President Compton.

Dr. Schneider is widely known for his research on television tubes, radar, the optical properties of solids in the extreme ultraviolet, and secondary electron emission. He was educated at Wesleyan University from which he was graduated with the degree of bachelor of science in 1929, after which he completed studies for the degree of doctor of philosophy at Harvard University in 1934.

From 1934 to 1936, Dr. Schneider was a research assistant at Harvard, in 1937 he was a research physicist for the Farnsworth Television Company, and during 1937 and 1938 he held a similar post with the Philco Radio and Television Company. He joined the department of physics at Stevens Institute of Technology as an instructor in 1938 and was appointed an assistant professor in 1939, a post which he has held until his appointment to M.I.T. Since 1945 he also served at Stevens Institute of Technology as assistant to the president for research.

During World War II he was granted leave of absence to join the staff of the Radiation Laboratory at M.I.T. where he carried on research from 1941 to 1945. During this period he was leader of a group which directed the development of ground radar for control of aircraft and for early warning. The instruments developed by this group played a vital part in the operations of the Army Air Forces in the war. From March to August, 1944, Dr. Schneider was in charge of ground radar developments at the British branch of the Radiation Laboratory. From 1944 to October, 1945, he was expert consultant to the Office of the Secretary of War and was a member of the Advisory Specialist Group, Far Eastern Air Forces, during the summer of 1945.

In 1946 Dr. Schneider was appointed chairman of the Electron Tube Panel of the Joint Research and Development Board. For his services during the war, Dr. Schneider was awarded the Bronze Star Medal for aid given the Army Air Forces in their use of radar in the Pacific.

Stratton Prizes

DURING the academic year of 1930–1931, President Samuel W. Stratton gave three cash prizes in establishment of a competition, open to all undergraduates of M.I.T., and intended to stimulate student interest in the national professional engineering societies and to encourage young men in the skillful preparation of scientific and engineering papers. Subsequently, friends of Dr. Stratton continued the awards, except for the period during World War II.

Papers presented on the evening of June 12, at Lowell Court, were: "Frequency Modulation" by James G. Ulmer, '47, IX-B, awarded first prize by the judges; "Atomic Radiation" by Joseph M. Rault, Jr., '48, XIII-C, awarded second prize; "Social Responsibilities of Science" by Vincent L. McKusick, '47, VI-A; and "Maintenance of Heavy Equipment Machinery" by Thornton E. Smith, '48, I.

Transcriptions of the M.I.T. Glee Club were played during the intermission, and informal dancing at Walker Memorial followed the conclusion of the contest.

To Broaden the Man

YOUR Committee * has reviewed with the members of the Administration the organization and facilities of M.I.T. which pertain to student living quarters, extracurricular activities, and athletics. During the war period these matters could be given but little attention. A comprehensive review has, therefore, been undertaken by the Administration, and plans for improvement are being developed.

The primary purpose of M.I.T. is to give young men and women an education specializing in engineering, science, architecture, and management. To do so requires elaborate laboratories, classrooms, and libraries, and the services of an extremely competent faculty. The studies required to qualify a student for a degree are so extensive that practically all of the student's time during nine months of the year for four years must be devoted to mastery of his studies. The educational standards of M.I.T. are the highest, and the Institute stands at the pinnacle of eminence in engineering and scientific teaching. Institute graduates are in the forefront in the various professions throughout the country. Nothing should be done to detract from the excellence of this engineering and scientific education.

It is possible, however, that through improved living conditions and through improved recreational facilities for the development of intramural and intercollegiate competitive athletics and the stimulation of other student activities, our engineering and scientific education can be greatly enriched and the quality of the M.I.T. graduate as a potential factor for good in American engineering and science thereby improved.

The Committee believes that the student should have comfortable and convenient living quarters, where he may associate with his fellow students and make those personal contacts which are so important.

M.I.T. extracurricular activities have in the past provided an excellent outlet for student interest, ingenuity, and enthusiasm. In athletics the Institute has, in some instances, been highly successful. At present more than two out of every three students take no part whatsoever in extracurricular athletics or activities. This is a student problem which should rest largely upon undergraduate ingenuity, but student participation should, in our opinion, be encouraged.

It is the belief of the Committee that athletics are highly beneficial and that they should be actively encouraged.

The Alumni Association has been most helpful in the conduct of activities and athletics. It has furnished advisory committees to assist and guide the students. Recently the Administration has placed greater responsibilities upon the office of the dean of students. This office is now called upon to exercise a degree of guidance over the dormitories, activities, and athletics. To assist the dean, a director of athletics has been appointed. The Committee is favorably impressed with this program and with the appointments which have been made.

An unusual opportunity for M.I.T. progress is at hand in the stimulation and expansion of student life and ac-

(*Continued on page 548*)

* Members of the Visiting Committee on Student Activity for 1946–1947 are: Donald F. Carpenter, '22, chairman, Horace W. McCurdy, '22, and J. Willard Hayden.

BUSINESS IN MOTION

To our Colleagues in American Business . . .

It is amazing how often trouble turns out to be the best of introductions, resulting in firm friendships and new customers. That has been Revere's experience throughout its long history.

Take the case of an important new invention, originally developed for war purposes but now being increasingly employed in valuable peace-time applications. At first, rejections were impossibly high, over 40%, costs were exorbitant, and production was so low that the great hopes held out for the device seemed almost impossible of realization, due to the limited numbers made.

At this point Revere, though it had not been supplying metal for the product, was asked if it would care to investigate the possibilities of breaking the bottleneck. Meeting with engineers under conditions of complete secrecy (which is not unusual for Revere during development work) the trouble was studied thoroughly. Conferences were long, and many possibilities were cooperatively explored. Eventually it was decided that a change should be made in fabrication methods, and also in the properties of the metal used.

These conclusions seemed so promising that a test run was made. It was completely successful. Subsequent production experience was most gratifying. Rejections were cut to less than 1%, production was stepped up to such a degree that the bottleneck simply ceased to exist, and costs were reduced to commercial levels, where they remain to this day.

This work was a mutual endeavor. No one person or organization can take the credit for it, which is typical of modern industry. A great many of today's products are so complex in conception, design, and manufacture that it is probably safe to say that no man or company can possibly have all the knowledge required to cure the various troubles that so often beset a business. It becomes necessary to call in outsiders having specialized experience, and for a time to make them insiders.

Suppliers to every industry have an enormous fund of information about their materials, whether they be metals or plastics, glass or chemicals. They know how they act under various conditions, which one is preferable under given circumstances and what improvements may be achieved by making changes. They cannot of course reveal confidential data acquired while working with customers, but their general fund of knowledge and experience is invaluable, and usually heightened by a fresh viewpoint.

Revere is not the only one to welcome trouble as an introduction and a challenge, not the only one with an open mind as well as an informed one, not the only one ready to question the customary and find new answers to new problems. So if you are a manufacturer seeking answers to difficult questions, searching for ways to make better products, more quickly and economically, I suggest you introduce your industry's suppliers to your difficulties, and ask their cooperation.

E. Donald Dallas

Chairman of the Board

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CLIFFORD *FeatherWeight* **ALL-ALUMINUM OIL COOLERS**

HYDRON Metal Bellows

HYDRAULICALLY-FORMED BELLOWS

THE INSTITUTE GAZETTE

(*Continued from page 544*)

tivities. Several years before World War II, M.I.T. wisely procured the tract of approximately 50 acres of land west of Massachusetts Avenue. On it an excellent track and field house were constructed. The site now stands ready for further development and it has been reserved for student and faculty living and recreational use; it is ideal for the purpose, and no scholastic expansion is planned in this area. The Administration has prepared preliminary plans for the development of this tract. These plans include a gymnasium, tennis courts, and fields for baseball, soccer, lacrosse, touch football, soft ball, and other games. There is also provision for the presently proposed Senior House and for many additional dormitories, a faculty club, fraternity houses, and so on. The Charles River Basin has provided excellent opportunities for crew and sailing, and use of it can be further expanded. The proper development of the excellent tract of land and the use of the Basin would profoundly change the atmosphere at M.I.T., and students would materially benefit thereby. James R. Killian, Jr., '26, Vice-president of the Institute, ably describes the objective as follows: "Altogether we want to contrive an environment here which performs in the broadest sense an educational function itself, not in a passive way but in a dynamic way. The whole complex of living conditions, activities, and atmosphere must be skillfully arranged to provide the kind of environment that will develop leadership, breadth, and standards of taste and judgment among our students."

In the opinion of the Committee the opportunity is at hand and we wish, therefore, to recommend for most serious consideration and adoption the following statement of policy in order that the importance of this phase of M.I.T. education may be given proper emphasis and that we may clarify our objectives:

Resolved: That it is in the interests of a sound educational program at M.I.T. to provide: (a) Dormitories adequate to accommodate the maximum number of students consistent with the housing needs of the student body and a stabilized enrollment at the Institute. (b) Athletic and recreational facilities adequate to accommodate all reasonable needs of student and faculty members who may wish to use them and to permit intercollegiate competition. (c) Facilities adequate for the conduct of extracurricular activities. (d) Administrative personnel adequate for the guidance and encouragement of a balanced extracurricular program for the student body. (e) Freshman participation in athletics as a part of the educational program.

Resolved Further: That maximum benefit from activities, including athletics, will be attained only when the students assume full responsibility for the operation of these activities, the Administration and the Alumni Association assisting in an advisory capacity only, except in such cases where more direct action may be required to protect the reputation or properties of M.I.T. or to avoid detrimental effect on the educational program.

Resolved Further: That the Administration and Executive Committee of the Corporation give these objectives serious consideration in the allocation of operating and capital funds.

Functionalism in Civil Engineering

WELL-ATTENDED meetings of the Visiting Committee on the Department of Civil and Sanitary Engineering* were held at M.I.T. on December 2 and 3, 1946, and at the Union League Club, New York City, on January 4, 1947. On December 2 the morning was spent in conference with Professor John B. Wilbur, '26, Head of the Department, while the afternoon was devoted to an inspection of Department facilities. The morning of December 3 was spent with staff members of the Department in conferences on the departmental divisions of Structural Engineering and Soil Mechanics, Hydraulic Engineering, Transportation Engineering and Surveying, and Sanitary Engineering.

During the past year, while the enrollment at the Institute as a whole has increased 108 per cent, the enrollment in the Department has increased by 125 per cent. Although perhaps primarily due to the increase in the total Institute enrollment, this increase is nevertheless gratifying and is among the factors that encourage a continuation of the aggressive and comprehensive program for the Department.

The proposed new hydrodynamics laboratory continues as the foremost need of the Department. Although some of the funds that will be needed for construction of it are in hand, an effort to increase this sum should rank high in the Institute's program. The Committee further recommends that funds be allocated now for the immediate preparation of the working drawings and specifications of the proposed laboratory. Only by such a procedure is it possible to insure readiness to begin actual construction without undue delay after sufficient funds have been raised and restrictions against construction have been removed.

Consideration should also be given to the development of a Sanitary Engineering research program, including the construction and operation of a pilot-type experimental station and the accumulation of basic data relating to the economical treatment of industrial wastes, alone and in combination with sewage. The facilities of the William Thompson Sedgwick Laboratories of Sanitary Science and the qualifications of the Sanitary Engineering staff make it possible for M.I.T. to undertake experimental research in co-operation with an industrial association or a government agency, to the benefit of both.

The Committee believes that the requirements for admission to the Graduate School for work in Sanitary Engineering should be modified to be more adaptable to varying and less specific kinds of undergraduate preparation. Such modifications are to be based on proper substitutions of alternate requirements which will lower neither the standards of the entrance requirements nor the ability of the student to pursue graduate work in his chosen sector of Sanitary Engineering.

The Committee urges the early resumption of research in the Cement and Concrete Laboratory of the Department. Steps have already been taken to insure that the renewal of this activity will be conducted in a manner such that it will be co-ordinated with the activities of

(*Continued on page 550*)

* Members of this Committee for 1946–1947 are: Thomas C. Desmond, '09, chairman, Allan R. Cullimore, '07, Walter D. Binger, '16, Duncan R. Linsley, '22, Horace W. McCurdy, '22, William H. Mueser, '22, and Beauchamp E. Smith.

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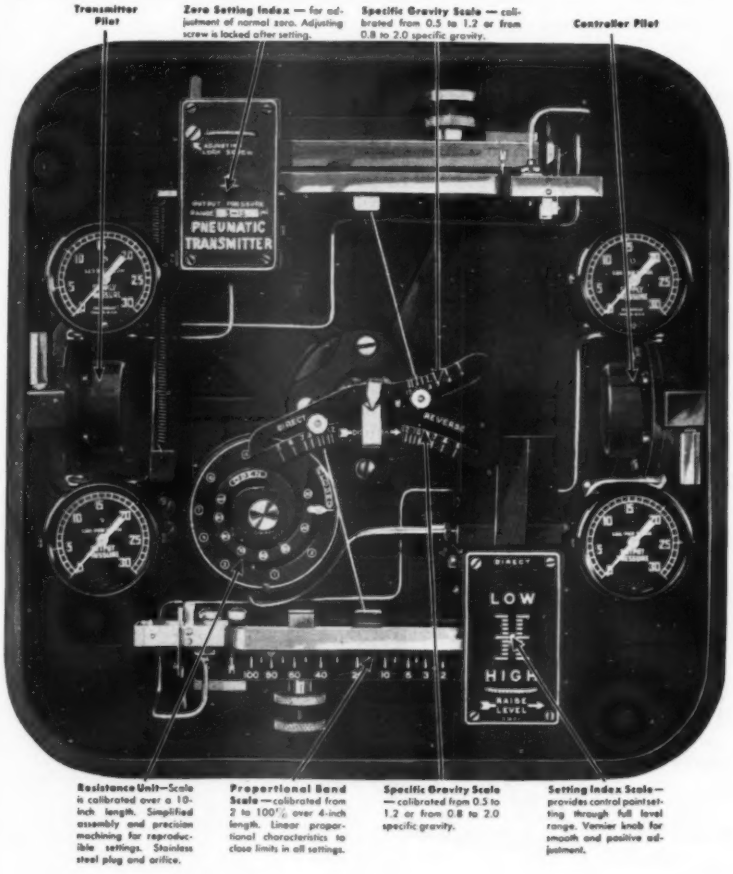
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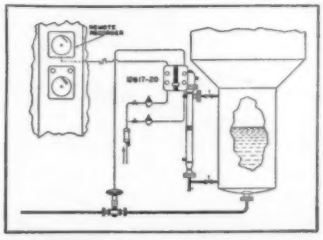

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THE INSTITUTE GAZETTE

(*Continued from page 548*)

other departments and thus place research in concrete at M.I.T. on the highest possible level. It is hoped that research in cement and concrete may be resumed as soon as the Department is able to add a staff member properly qualified to head this activity.

The establishment of a photogrammetry laboratory remains as an objective that has our continued support. Space for this purpose has been earmarked for the Department, but further development requires the appropriation of $7,500 for the purchase of equipment which the Committee recommends.

The Committee has studied with much interest Professor Wilbur's proposal that the undergraduate curriculum in Civil Engineering be substantially revised so that options are based on functional, rather than technical, considerations. The present curriculum offers four options: Sanitary Engineering, Transportation Engineering, Hydraulic Engineering, and general Civil Engineering, the latter of which gives abbreviated work in each of the three more specialized fields. Some variation exists as to the content in the different options, but the educational aim behind each is similar in that the effort is to train men in the fundamentals of civil engineering so that they will be well prepared for professionsal work. Without belittling the importance of such training, some members of the Committee feel that the curriculum as now set up has a goal which may be too restricted; that it fails to recognize other objectives; and that it is not wholly adaptable to the incorporation of potentially important new trends.

Instead of setting up options on the basis of various technical phases involved in civil engineering, it is felt that it may be desirable to establish options which differentiate between the types of mental effort involved in civil engineering activities. Although representing an oversimplification, it may be said that a civil engineering project involves three phases: (1) conception; (2) design; and (3) construction.

Based on the foregoing approach, the following three options have been suggested:

Option I: The Theory and Design option would aim to serve the needs of students who wish to become technical specialists. Structural theory, fluid mechanics, soil mechanics, and so on, would be emphasized. In general, technical professional subjects would be presented on a broad base so that the principles taught would be applicable to the solution of problems not restricted to the field of civil engineering. The curriculum would be similar to the present undergraduate Course in Civil Engineering.

Option II: An option in Planning and Administration, intended for those who are primarily interested in the planning and administration of construction projects, would provide a civil engineering background with emphasis on the social aspects of civil engineering projects. Methods of conservation, highway and airport engineering, flood control, and similar topics would be included in this option. Undergraduate Sanitary Engineering could be incorporated into this option by means of special electives in Sanitary Chemistry and Bacteriology.

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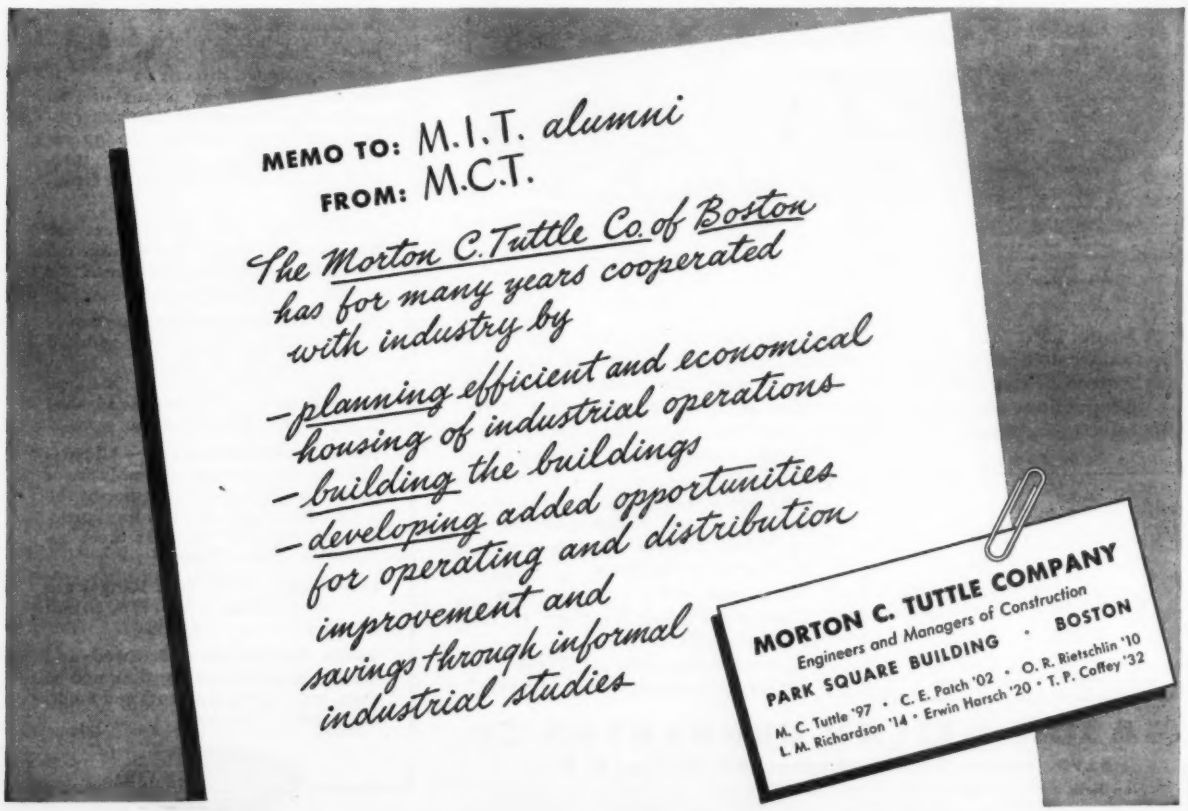
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FROM: M.C.T.
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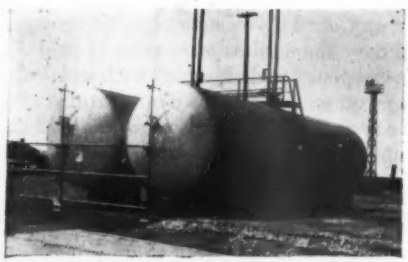

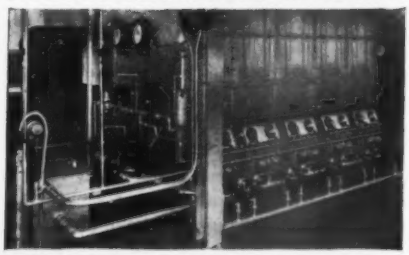

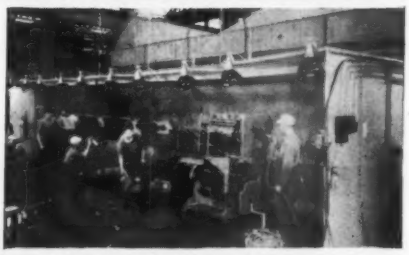

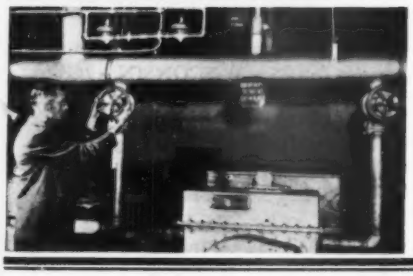

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THE INSTITUTE GAZETTE

(*Concluded from page 550*)

Option III: For men who are primarily interested in general construction work, many of whom will wish to become contractors, an option would be established in Construction and Management. More work immediately applicable to practical problems would be given in this option than in the others. Emphasis would be placed on certain business subjects and on the characteristics of construction materials.

Professor Wilbur presented a tentative curriculum for discussion and the following points were brought out:

(1) The suggested curriculum departs from the present curriculum in the third year.

(2) The suggested curriculum makes increased use of subjects taught by other departments and requires the Civil Engineering Department to teach very few new subjects.

(3) A transition to the new schedule would not be too difficult, since students now enrolled would be essentially in Option I of the new curriculum. New second-year students could begin their chosen option at the time the new program went into effect.

(4) This proposal appears to offer more comprehensive training in Civil Engineering than is possible with the present curriculum.

The Committee believes the curriculum proposed by Prof. Wilbur would represent a decided step forward and that the Department should be encouraged to put into effect carefully considered revisions based on these principles.

ADDRESS TO THE GRADUATES

(*Continued from page 532*)

Now the unions are the target of attack, and the Taft-Hartley bill to regulate them may soon be enacted.

I need not elaborate further on the fact that you have already lived through troublesome but stimulating fluctuations in the political climate of our democracy. You will participate in more of them in the years ahead. May you do your part well in the effort always to find and to follow the better way. And if you sometimes feel confused and discouraged over the endless succession of problems and the lack of consistency and efficiency with which they are handled, may you remember this democratic analogy to the temperate zone, and that such problems and fluctuations make in the long run for social strength, and take courage.

Finally, let me express a thought which is both an encouragement and an appeal to you as you meet and react to the situations ahead. It is this. Your professional training has emphasized, above all else, objective analysis of problems and skillful, constructive solutions to them. There is no place in science or technology for personal prejudice or selfishness; the whole emphasis is on the facts and the conclusions which logically follow. There is no place for half-baked opinions or slovenly performance; the scientist or engineer or architect is expected to speak only when competently informed and to act always with skill and good reason. These things are part of the code of ethics of the technological profession. The major purpose of our education is to create the habits, implant the knowledge, and develop the skills which will insure ob-

(*Continued on page 554*)

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DIVISIONS OF
AMERICAN GAGE & MACHINE CO.
Engineering Representatives in Principal Cities

To Technology Men in SAFETY ENGINEERING:

• *Do you like spilled gasoline?*

The Department of Safety, American Petroleum Institute, included the following in a February, 1947, bulletin:

AUTOMOBILE CATCHES FIRE

"A car was driven into a service station for gas and the engine was left running while the station attendant filled the tank. During the operation the engine almost stopped running and the driver choked it, causing the engine to back-fire and burst into flame.

"The car was destroyed by the fire and the occupants were badly burned — one fatally.

"It is an unsafe practice to allow the engine to run while getting the tank filled with gasoline."

The engine should not be left running. However, a back-fire, of itself would probably not have caused the fatality.

A constructive step would be to correct conditions, now inherent in tank design, which cause the spillage of gasoline.

It is our contention that a well-designed gasoline tank should be capable of receiving the full pumping speed of the modern commercial pump — approximately fifteen gallons per minute — without blowback. The tank should incorporate an expansion zone to provide for temperature changes. The filler neck should discharge at the bottom of the tank — thus eliminating evaporation and excessive vapors during filling.

And finally — the tank should have some positive means to advise the attendant when the fuel has reached a pre-determined level within the tank. That is the function of the VENTALARM* gasoline tank fill signal — now standard equipment on fifteen makes of automotive vehicles. One simple rule suffices — "Fill 'til the whistle stops".

As safety engineers, you can play an important role in the improvement of gasoline tank design. Your comments would be appreciated.

Yours for safe filling tanks,

Frank P Scully
M.I.T. '15

P.S. And, incidentally, the VENTALARM fuel oil tank signal is now assuring safe filling of over a million home fuel oil tanks.

*T. M. REG. U. S. PAT. OFF.

SCULLY SIGNAL COMPANY • 98 FIRST STREET, CAMBRIDGE 41, MASS.

ADDRESS TO THE GRADUATES

(*Continued from page 552*)

jective and constructive performance. Such performance in technological matters we take for granted.

I believe that the discipline of objective, analytical, and constructive approach to scientific and technical problems tends to carry these same attributes over into the great variety of nontechnical fields. I believe that men and women, trained as you have been, are more likely than the average person to make honest, unprejudiced and unselfish judgments and are, therefore, more likely to arrive at sound conclusions. I think this is especially likely to be true if you stop from time to time to think about it and check yourself to see whether, in reacting to social or political problems, you are being guided by the requirements of careful analysis and the logic of constructive conclusions.

I would not imply that people with your training have any monopoly of honest judgment, for, thank God, there are many people from many walks of life who have it through conscience and good sense. But the world desperately needs many more people who will react unselfishly and clearheadedly, and who will then act unselfishly and competently. Every problem in industrial relations, in political action, and in international relations calls for such approach by all concerned, and that means by all of us.

One nice illustration of the qualities of which I am speaking was in the leading editorial in last Saturday's Boston *Herald* of June 7. Who wrote it I do not know. He was probably not a scientist or engineer or architect and I would guess that he was probably educated in our big sister institution up the river. But he did show the quality of unprejudiced analytical thinking that I have in mind when he pointed out the distinction between communism as a social philosophy and the acts of a nation ruled by a particular communist party with its leaders. The editorial went on to say:

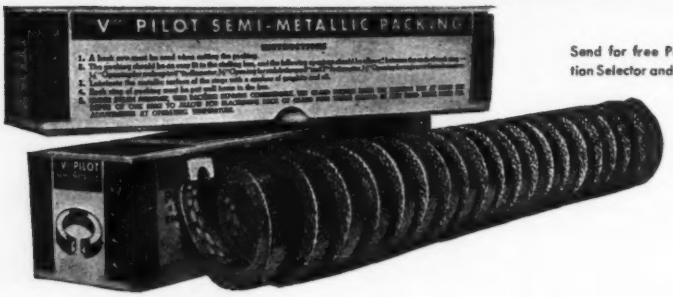
> It is not the communism of Russia against which we are forming our front. It is the aggressive nationalism of Russia. That distinction is important. It is no "proletarian democracy" that tried to gouge heavy reparations out of the Italian masses, that is denying the Korean people a chance to realize their destiny, that is looting machinery from Manchurian labor, that is imposing an unequal peace on the Chinese, that is draining foodstuffs from her satellites. If Russia were a capitalist state, and behaved as she has, we should still need to gather our potential allies.

This is just a random illustration which happened to be at hand when I wrote this address. It does not solve the problem of our relations with Russia. It is simply one example of how we can get our emotions and judgments confused by unanalytical reactions to phrases like communism, democracy, the flag, fair employment practice, the world owes every man a living, military strength produces wars, and many others.

The important thing is to understand just what are the facts and causes back of the situations thus described, and then to take the wisest constructive action which is realistically possible. This is what the pure and applied scientist is trained to do in his relatively simple field of professional operations. I hope it is also the type of approach to the

(*Concluded on page 556*)

"V" PILOT
SEMI-METALLIC PACKING



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"V" Pilot Semi-Metallic Packing in spiral form, comes in 10 foot lengths, and in sizes from 3/16" up to 2½", advancing by sixteenths

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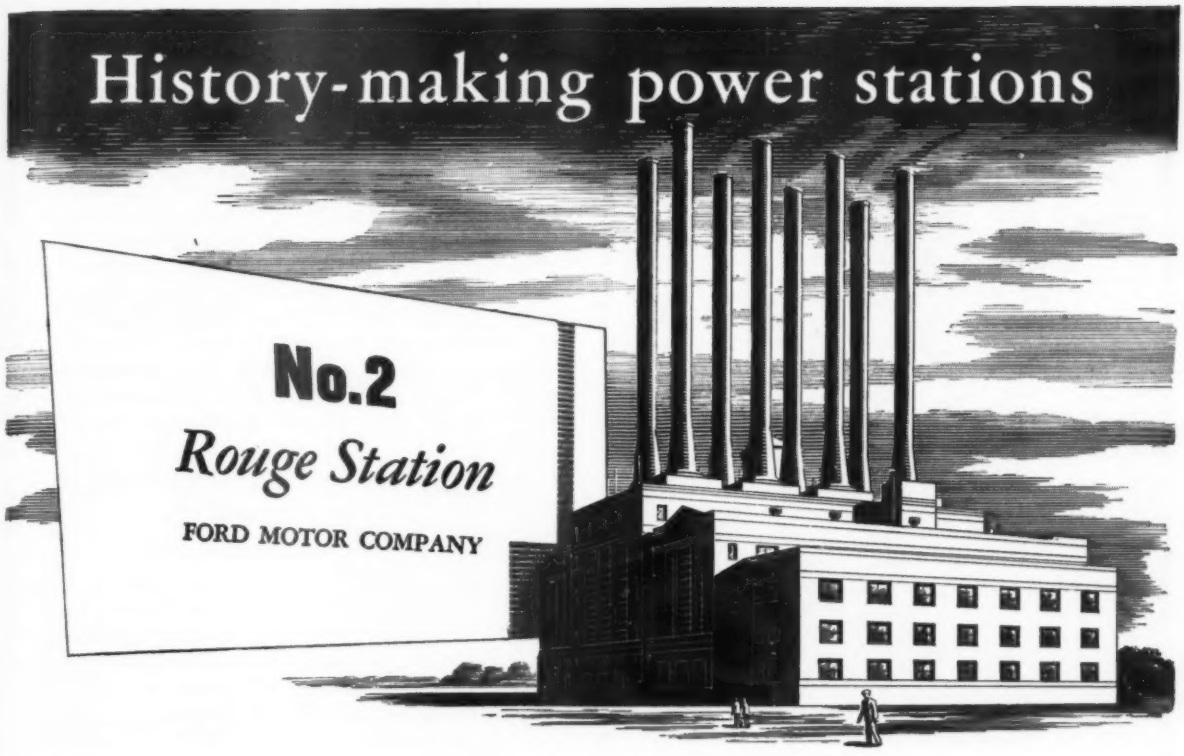
BRANCHES: PHILADELPHIA BALTIMORE BOSTON SAN FRANCISCO NORFOLK CHICAGO FACTORY: SEA CLIFF, N. Y

History-making power stations



Mere size, of course, makes Rouge Station, located on the River Rouge in Detroit, notable. It has long been the largest steam electric power station serving any industrial establishment, anywhere. But beyond this, Rouge has contributed importantly to the major advances in steam generation.

In 1920, when the vast majority of engineers regarded pulverized coal firing as still in the experimental stage, Ford engineers had the courage to apply this new method to eight boilers each capable of producing 200,000 pounds of steam per hour — by far the largest boilers ever built up to that time! The success of this huge installation gave a tremendous impetus to the use of pulverized coal.

Yet in five years, four of these eight boilers were rebuilt to double their capacity; while in ten years two of these still modern boilers were completely replaced with the largest super-pressure boilers built up to then — 1400 pound pressure, each with a capacity of 700,000 pounds of steam per hour. Finally, in 1939, the remaining two original boilers were replaced by 1400-pound pressure units, and the capacity climbed to 1,000,000 pounds of steam per hour for each of the new units.

In short, within twenty years and in the same floor space, Industry's most modern power plant had replaced or rebuilt all its original boilers and nearly quadrupled its original capacity.

In this history-making development of Rouge, the boilers and all related equipment from the first installation through every stage of modernization up to the present were designed and built by Combustion Engineering.

B-135

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Experience — *to interpret, from a world-wide background in every important industry, the specific needs of each installation.*

Facilities — *to manufacture complete steam generating units for every capacity from 1000 pounds of steam per hour up to the largest.*

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ADDRESS TO THE GRADUATES

(*Concluded from page 554*)

more complex problems of community life which you will follow — subconsciously because of your training and consciously because you know that such approach is sound and greatly needed.

So, members of the Class of 1947, on behalf of the Corporation and Faculty of this institution, I bid you Godspeed in your new interests and activities. I congratulate you on the opportunities for growth and satisfactions which will be afforded you by the difficulties you will encounter. I trust that you will meet all problems in the objective and constructive spirit of science. And I wish every one of you every well-deserved success, with a goodly share of good luck thrown in for good measure. I say "farewell" to you as students; I greet you as Alumni.

PROBLEMS OF ATOMIC ENERGY COMMISSION

(*Continued from page 530*)

In illustrating the job to be done, it may be useful to consider the responsibilities of the Commission's field manager. He is responsible for the administration of the Commission's operations at Oak Ridge. These include the management of a city of 40,000 people, entirely owned by the Government and for which city management services are now furnished by a contractor. The contractor, in turn, lets concessions for numerous community services and stores, maintains all the community property, issues leases, collects rent, furnishes the fire and police forces, and handles a multitude of other operating and administrative problems for the community. This contractor operates under the direct and close supervision of the field manager and his staff. The field manager represents the Commission in dealing with the contractor operating the Clinton Laboratories — a large research and development laboratory and isotope production factory — and administers the contract for the operation of the gaseous diffusion plant and the electromagnetic separation plant. Together, these two plants represent an investment of $900,000,000. The field manager and his staff must insure that these operations are carried on with proper fiscal and inventory control of the precious material, and that the plants are operated efficiently and in accordance with production schedules and requirements of the Commission as a whole. He is also responsible for the maintenance of security at these plants and laboratories, and for the promotion of satisfactory industrial relations, and must provide the community with satisfactory government.

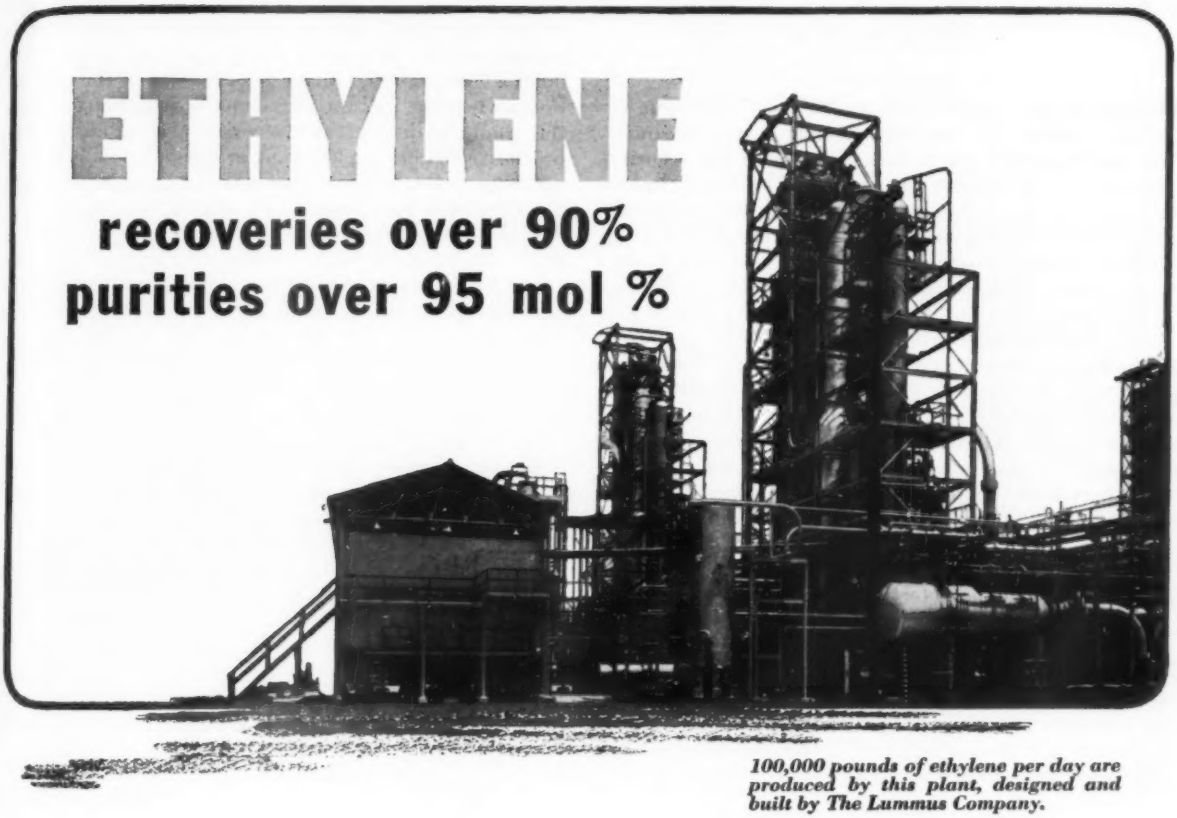
To administer such responsibilities, the field manager needs a broad delegation of authority. He must, however, be sensitive to policy questions and always have in mind that his operation is one of a series of integrated, interdependent steps in the over-all operations of the Commission. This job is large by any standard. It holds a great challenge and should attract the highest type of administrative talent, despite inability of the Commission to pay salaries which compete with those paid by private enterprise.

Another position of great importance is that of director of security on the staff of the general manager in Washington. The director of security will be responsible for the

(*Continued on page 558*)

ETHYLENE

recoveries over 90%
purities over 95 mol %



100,000 pounds of ethylene per day are produced by this plant, designed and built by The Lummus Company.

. . . without low-temperature refrigeration

In 1943 Lummus completed construction of an ethylene plant for one of the nation's best known chemical companies. With this plant (the first to employ the absorption process for the purification of ethylene) the company has consistently obtained high ethylene recoveries (over 90%) and purities (up to 95 mol %) without use of extreme low-temperature refrigeration.

Among other basic advantages which Lummus incorporated in this plant are flexibility, economical resolution of the charge and furnace effluent gas streams, and ease of control.

Lummus is currently completing construction of two similar ethylene plants with even higher purity—99+mol % ethylene.

With complete research and construction facilities—and with broad experience in petroleum refining and chemical production—Lummus is well prepared to design and build your facilities for the production of ethylene, propylene, phenol, and other chemicals from petroleum.

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LONDON—78 Mount Street, London, W. 1, England

PROBLEMS OF ATOMIC ENERGY COMMISSION

(*Continued from page 556*)

formulation and recommendation to the Commission of security policies for the entire atomic energy program. Not only must he act in accordance with the security provisions of the Atomic Energy Act of 1946, but, to the best of his ability and judgment he must also institute all precautions and safeguards necessary for the protection of facilities, materials, and information of vital importance to the common defense and security of the United States.

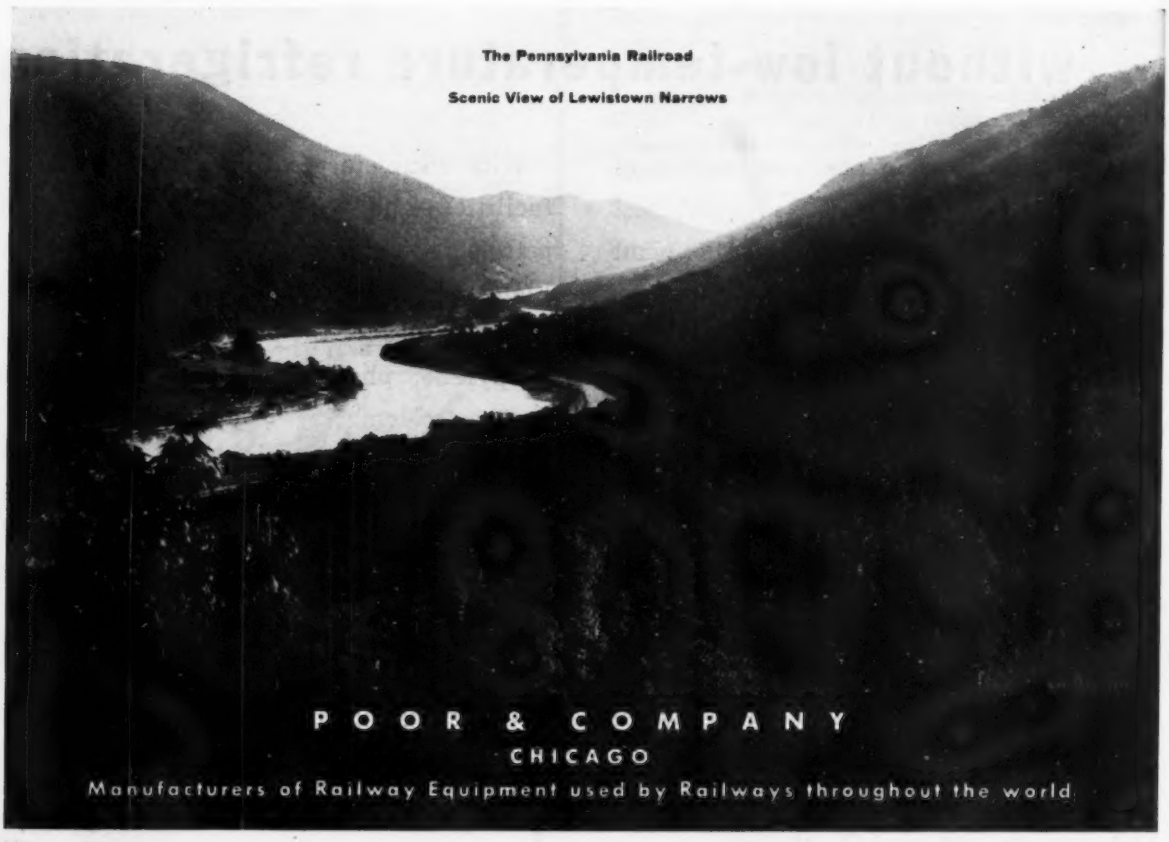
The Commission's work is carried on in several hundred places. Each of them has to be protected. Every employee of the Commission and its contractors who, in the course of his work has access to classified information or equipment, must be fully investigated by the Federal Bureau of Investigation. The director of security is responsible for the establishment and prompt operation of the Commission's part in this enormous investigative activity. He has responsibility to the Commission for recommendations regarding the employment of personnel. He must cooperate with the Federal Bureau of Investigation and other agencies in the detection of violations of the provisions of the law relating to security.

Under the Act, the Commission is directed to activate "the policy of the people of the United States, that, subject at all times to the paramount objective of assuring the common defense and security, the development and utilization of atomic energy shall, so far as practicable, be directed toward improving public welfare, increasing the standard of living, strengthening free competition and private enterprise, and promoting world peace." It is further directed to conduct research and development to build a "program of Government control of the production, ownership, and use of fissionable material to assure the common defense and security and to insure the broadest possible exploitation of these fields." This is quite an order. The Commission must utilize the best practices of free enterprise and of government. It must establish programs which will reconcile widely differing practices among private employers and between the Federal service and private business. This must be done without destroying or subjugating the rights and privileges of the employee or the employer. In order to do its job, the Commission must obtain personnel of exceptional qualities, capable of developing new patterns of co-operation between the Government and private organizations.

The Commission must endeavor to minimize differentials in relation to salary and wage policies among those of its contractors who conduct similar operations. Moreover, to avoid loss of Commission employees to contractors, the personnel policies and salaries paid by the Commission must, in so far as possible, be adjusted to meet the competitive pull of private employers with whom the Commission is dealing on a very wide variety of problems.

A major task of the Commission itself, which will call for great imagination, inventiveness, appreciation of industrial motivation, and shrewdness, is the discovery and development of incentives to industry to devote some of its best people and energies to various aspects of this

(*Continued on page 560*)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A SUBSIDIARY OF STONE & WEBSTER, INC.

PROBLEMS OF ATOMIC ENERGY COMMISSION

(*Continued from page 558*)

broad program. At this stage in the development of a new art, the expenditures required for further research and development are large, and the prospects of commercial profit are difficult to appraise. As contrasted with the war period, industrial firms are naturally, and rightly, motivated by profit incentives. The stockholders expect industrial firms to make money, and so do the employees. Management, therefore, has a responsibility to devote the energies and resources of a company to those activities which hold prospect of fair and reasonable profit.

If, in this country, we are to exploit fully the possibilities which atomic energy holds in store and to provide a broad and strong foundation for this exploitation, we must create what might be called an atomic industry. This is important not only for the commercial possibilities which will certainly be developed, but also for our common defense and security. The building of an atomic industry calls for the closest kind of partnership between the Commission and industry. There is very great responsibility on both parties to evolve together the patterns which will promote the growth of industrial strength in this field.

In the future, when the necessary power reactors are able to generate electric power economically, we may be sure that the necessary power reactor will consist of a great many components. It will be very much more complicated than any present-day boiler. It will include the reactor itself made of special materials; there will be a number of auxiliaries, such as pumps, seals, blowers, valves, coolants, heat exchangers, and a great array of instruments for accurate control. It will be housed in buildings of special design; it will include associated chemical separation and recovery equipment. There will be numerous safety devices to insure the safe control and operation of the reactor. All of these parts, as well as the design and building of this assembly, should be done by industry. There should be enough firms with the knowledge and capacity to provide lively competition among them in the production of the best and cheapest components. Other uses are certain to be found for many of the products originally developed for the new atomic industry. New materials, upon which successful design and construction of power reactors depend in such large measure, will be developed, and we may be sure that most of these will have many other useful applications in industry.

We must bring about a very wide participation by many institutions in advancing knowledge by research and development, for we are continually bumping up against the frontiers of scientific knowledge. Similarly, in the development, design, construction, and operation of the reactors of the future, there must be a wide participation by American industry. Only if this enterprise is one in which broad segments of the whole American economy participate will it be possible soundly and quickly to go forward toward the realization of the great potentialities which atomic power must hold.

Much experimentation is involved in discovering ways in which industrial groups may be brought into a solid

(*Continued on page 562*)

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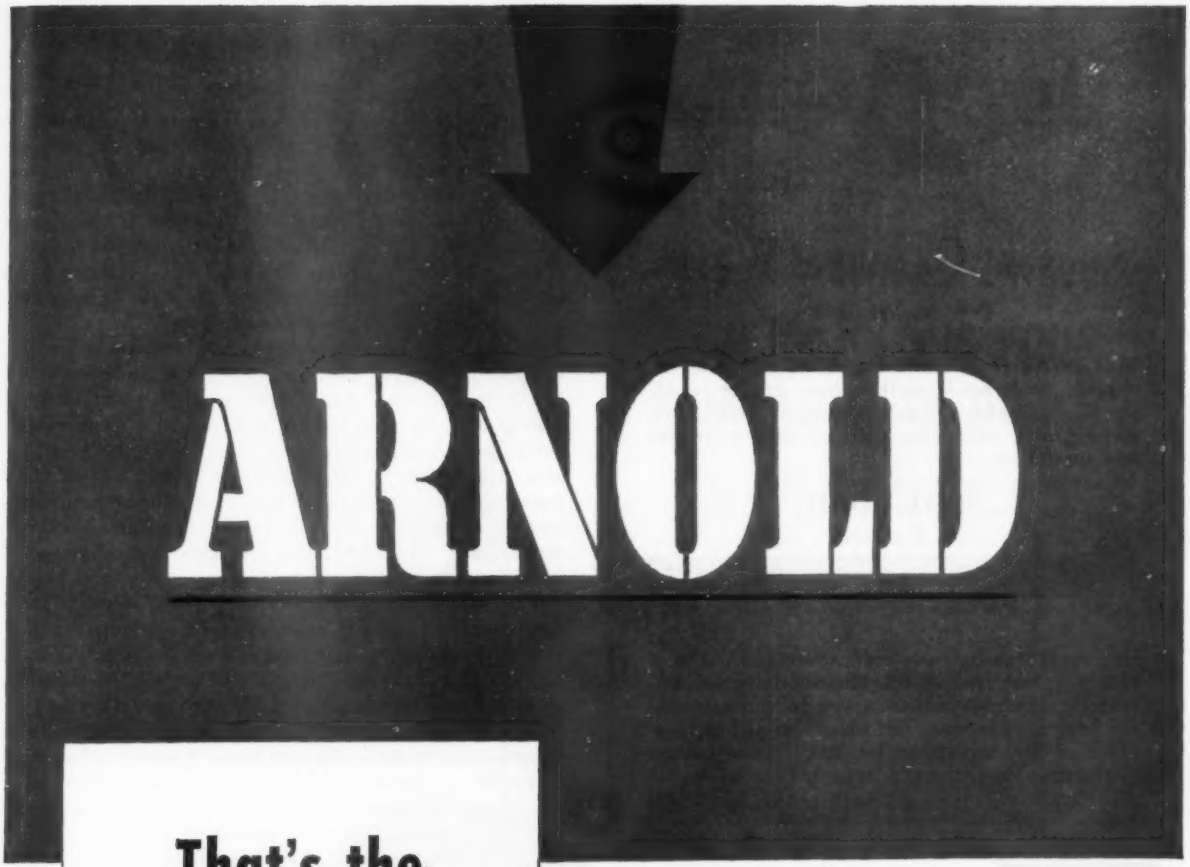

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PROBLEMS OF ATOMIC ENERGY COMMISSION

(*Continued from page 560*)

participation in this enterprise. Some of the hurdles are clear, such as those growing out of security restrictions. The way is largely uncharted; there is no book of answers and few precedents to use as guides. Mistakes will be made, but we must go forward. Unless we try many new administrative devices with full knowledge that some will bring criticism and others will fail, this enterprise will be mediocre and fall tragically short of the expectations and requirements of the American people.

Of all these problems probably the toughest is security, for here the pitfalls are deepest and the guideposts practically nonexistent. As Americans you expect that our secrets will be safely kept until we are assured that satisfactory international controls are established. You also expect that progress in atomic energy will go ahead rapidly, for you know that this nation must maintain a position of leadership. Yet these expectations are, in a sense, quite conflicting, and give rise to a dilemma not easily resolved.

For maximum protection of our present secret information we might lock up every bit of knowledge we have and impound every new idea our scientists produce. In this freezing of the present status of knowledge, we would create a sort of informational Maginot line. On the other hand, to achieve the most rapid scientific and technical progress we might make our present secret information generally available in the conviction that freedom of discussion and prompt publication of scientific results are the lifeblood of scientific advance. Neither of these courses is acceptable and we must find some reasonable balance between them. This, I assure you, is no easy task.

I have probably said enough to indicate the kind of complex problems which the Atomic Energy Commission must resolve promptly, soundly, and by democratic methods. This calls for building a staff of the most competent men we can find. They must have integrity, judgment, imagination, and courage. They must prove themselves capable of resolving many issues and giving impetus to the enterprise upon the success of which so much depends. This project must succeed.

We need talent from many fields — men who are flexible yet experienced as comptrollers, budget officers, personnel directors, industrial relations experts, lawyers, engineers, scientists, and administrators. The numbers needed are small, but their talents must be exceptional. Many thousands have applied to the Commission for employment and among them we will find some to fill the posts. Very often, when we find just the right man he is in a position from which he cannot easily be spared, for others have already discovered his talents and have put him in a key place. Such men, or their employers, may be inclined to offer many reasons why someone else should be found. Unless such an attitude is the exception, rather than the rule, this enterprise will be mediocre and therefore a failure, and the price of failure may well mean the loss of leadership of this country in world affairs. It could even mean our eventual decline to a position of a second-rate power with the train of tragic circumstances which would surely follow. Or failure might come about in another way. The Commission might succeed temporarily

(*Concluded on page 564*)

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(Air-Spaced)
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HRT Knob....Net price....$ .75

National Company, Inc.

Malden, Mass.

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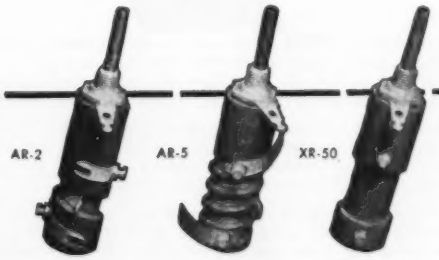
HRS-1 Knob....ON-OFF through 30° rotation.....Net price.....$ .51
HRS-2 Knob....5-0-5 through 180° rotation.....Net price.....$ .51
HRS-3 Knob....0-10 through 300° rotation.....Net price.....$ .51



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XR-50 coil forms may be wound as desired to provide a permeability tuned coil. The form winding length is 11/16" and the form winding diameter is ½". The iron slug is ⅜" diameter by ½" long.

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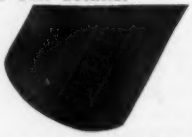

SIMPLEX WIRE & CABLE CO.

79 Sidney St., Cambridge 39, Mass.

PROBLEMS OF ATOMIC ENERGY COMMISSION

(*Concluded from page 562*)

in a material sense but in so doing undermine our system of free enterprise and some of our most cherished civil liberties.

I remember well the day in June, 15 years ago, when, as a member of the graduating class, I received my diploma from President Compton. It was a time of crisis in this country and throughout the world. We were in the depths of the most severe economic depression. Signs were plentiful that the members of the Class of 1932 were not going to have an easy time. We knew we would have to work hard — that each in his own way would have to find his opportunity not only to make a living but also to improve the environment in which we live and work.

I am sure that the Class of 1947 has few illusions that men can live privately any longer. Many of them have served in the most costly and bloody war in history, which has been succeeded now by an uneasy peace in which deep conflicts between the victors are starkly evident. As we survey the condition of affairs, both domestic and international, the patterns of behavior, the tools of action are, on the whole, sadly conventional. The most significant new thing in this scene is atomic energy — a force which holds awesome possibilities for good and for evil. Most people sense that the development of atomic energy will, and already has, profoundly affected the framework in which they live and work and that we have seen only the beginning of these effects thus far. We and our children will see much more.

Perhaps the most prevalent feeling people have in relation to this subject is fear. They have reacted to its fearful potentialities as a weapon and the prophets of doom have not let them forget what atomic warfare might mean to them or their children. People feel uneasy about the effects of the development of atomic energy — on their business, on their jobs. And they wonder what they as individuals can do about it.

There are quite a few things they can do about it and in time there will be many more. As M.I.T. men there are things that you can do about it. First of all, you can try to understand better what "it" is. It is not so abstruse but that with your background and a moderate amount of effort you can understand a good deal about the principles and problems of atomic energy. As some grasp of the essentials is gained, the mystery diminishes and with it the unreasoned fear felt by so many. When understanding is gained it should be passed to others.

There are other things you can do. The Commission needs your help in finding the men whose services are required to make this enterprise a success. If such men are now employed by you, we need your help, even your sacrifice, in enlisting their interest and participation in this great task.

We face the world's most exciting and momentous experiment in a partnership between government and private organizations in the development of an unparalleled resource. Our task carries a responsibility second only to that of the armed forces for the common defense and security of the United States. This enterprise belongs to the American people who must individually and collectively bear responsibility for its success and support.

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Hugo H. Hanson, *Class 1912*
Charles J. Fisher, *Class February, 1946*

UNITED NATIONS COMMENCEMENT

(*Continued from page 534*)

of sovereignty; yet the United States Government and its peoples have always been most loath to derogate their precious independence. We ask for genuine safeguards that the atom bomb will never be used against any nation; yet we are today the sole possessors of it and the most able of any nation to develop its potentialities. We ask that all nations, for the common good, join in the peaceful development of atomic energy; yet we today have a monopoly in this field and for years to come could probably keep the leadership in this development.

It may be that we shall make little apparent progress for some time to come in these negotiations and in the related negotiations on the regulation and reduction of conventional armaments. But even if this proves to be the case, I am certain that continued study and discussion will, in themselves, bear fruit in the end.

We should never permit ourselves to be driven into inaction or despair by apparent stalemates. The United States, with half the productive power of the world, has decisive power to create the conditions of permanent peace. If we conserve our strength and use it rightly, to a large extent, we can influence the world in the direction of the political and economic stability and democratic achievement that are essential to collective security.

To you veterans whose best years for academic life were sacrificed on the altar of freedom, this expression of faith in the ultimate consolidation of your victory is a meed of praise and thanks.

The so-called veto should not be so great a cause of concern as it has become. There is no veto anywhere in the United Nations except in the Security Council itself. There is no veto in the General Assembly, the International Court of Justice, the Economic and Social Council, the Trusteeship Council or in any of the specialized agencies, such as the World Bank and Fund and the Food and Agriculture Organization. Through these institutions, nations which are ready to plan and act together can do whatever they decide to do with an enlightened world opinion behind the decisions of the majority. Even in the Security Council the exercise of the veto is limited both by the charter and by the power of public opinion. No nation can, in the long run, prevent the achievement of the majority will.

Organization of Efforts

We, in the United States, must assert the conviction that we can do co-operatively and by agreement what must somehow be done — that we *can* peacefully apply what science has taught us — that we *can* find ways to realize and organize the productive and creative powers of people on a world-wide basis through the democratic processes set forth in the United Nations charter.

Above all, we must reject the folly of those who talk of the inevitability of another war because there are serious differences of ideology and interest between East and West. Those who talk in these terms lack faith in the capacity of America to exert her great moral, political, and economic strength in behalf of peace. They have lost or forgotten that faith in man and his capacity for good,

(*Concluded on page 568*)

IT TAKES TWO — to prevent loss

TOO often insurance is regarded as a formal agreement of indemnity against loss rather than as being the mutual effort of management and underwriter to protect against and prevent loss.

More than 111 years ago the industrialists who founded Manufacturers Mutual knew that indemnity for destruction of real property did not fully compensate against lost production and business volume . . . that loss prevention guided by independent research in cooperation with management gave fuller assurance of a continuing production with lower rates for insurance protection.

Have one of our Engineers show you how Prevention-Protection service works with management to prevent loss and reduce premium costs. Yes, it takes two to prevent loss.

Harvey J. Freeman '16
PRESIDENT

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UNITED NATIONS COMMENCEMENT

(*Concluded from page 566*)

no matter what his race or creed, which is the rock upon which our country was founded and has become great.

The building of a peaceful world society, collectively secure, was begun two years ago this month. The building will not be completed in my lifetime, although it may be in yours, who are about to launch upon your careers. Fifty years of devoted and persistent effort, in which all citizens participate, might be sufficient. It took longer than that to establish finally this great Federal Union of ours. There will inevitably be periods of setback and of discouragement, such as the period through which we are now passing, as well as periods of progress and hope, like those of the San Francisco Conference and last fall's General Assembly.

Through all these ups and downs we must prevent any act that would destroy the United Nations and split the world irrevocably into rival camps. The fundamental premise of universality upon which the United Nations was founded is, in every way, as sound and applicable today as it ever was. So long as the United Nations exists, the disagreements and rivalries of the world can be conciliated and contained within its framework.

The United Nations will continue to exist, and to grow in strength, if Americans will give their support, with understanding, with sacrifice and hard work, and with steady faith and zeal.

FUTURE OF GAS TURBINES

(*Continued from page 528*)

immediately and cannot be kept waiting. The traffic control devices now being installed at major airports will have to be more universally employed and they will have to be much better than they are now.

Bumpy air gives passengers an unpleasant ride, especially at high speed. As speeds have increased, such unpleasantness has been minimized by concurrent increases in wing loading made possible by more efficient high-lift devices. It is probable that the limit of improvement has been approached in this respect. But if not, and if something like boundary layer control is developed which gives a large increase in maximum lift and thus permits reduction in wing area, there will immediately arise difficulty in finding enough room in these smaller wings for the large fuel loads which jet airplanes require. It is possible, therefore, that the limit on speed will be set by the comfort of the passenger rather than by the power of the engines.

Of course, jet engines do have advantages as far as the comfort of the passenger is concerned. They are smooth, the noise of the propeller is absent, and the noise of the engine is rather easily dissipated and insulated against.

The turbine engine with propeller, as distinct from the pure jet, may be expected to come into the commercial field as a replacement for the reciprocating engine in planes very similar to the ones we have today, unless considerable improvements in the latter type of engine give the reciprocating engine a new lease on life.

The gas turbine undoubtedly has a great future in the field of aviation. At present it is too expensive and it has

(*Concluded on page 570*)

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HEAT TREATING APPLICATIONS

Neutral Hardening Baths

1. Tempering high speed steels
2. Hardening tool steels
3. Hardening production parts
4. Spheroidizing or annealing steel
5. Hardening SAE steels
6. Annealing carbon steels
7. Heating medium for spinning and forming
8. Hardening High Carbon High Chrome steels
9. Hardening stainless steels and cutlery
10. Bright hardening stainless steels
11. Descaling stainless steels

Tempering Baths

1. Solution treatment of aluminum alloys
2. Tempering production parts and tool steels
3. Hardening Beryllium alloys
4. Martempering production parts
5. Age hardening aluminum alloys

Austempering, Martempering and Isothermal Baths

1. Hardening tool and SAE steels
2. Annealing SAE steels
3. Controlled quenching to eliminate distortion
4. Quenching SAE steels
5. Austempering
6. Hot quenching stainless steels
7. Quenching production parts

Annealing Baths

1. Annealing brass and copper
2. Annealing nickel silver
3. Annealing silver
4. Annealing gold and platinum, and other precious metals at above 1000° F.

High Speed Steel Baths

1. Preheating high speed steels
2. Hardening tool steels
3. Hardening steel production parts

Secondary Hardening of High Speed Steels

1. Increase surface hardness of high speed tools
2. Remedy for soft skin due to faulty hardening
3. Increase life of high speed steel tools 300%

Bluing and Blacking Baths

1. Bluing and blacking production parts

Bright Temper and Descaling Bath

1. Bright tempering steel parts
2. Descaling steel parts

Carburizing Baths

1. Rapid carburizing from 0.001–0.040″ depth
2. Rapid heating of dies, etc., for hardening where soft skin occurs
3. Carburizing to a depth of 0.050″ or more

Brazing Baths

1. Copper
2. Brass
3. Silver

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WRITE FOR BULLETIN TR-125 • HAIG SOLAKIAN, Sc.D., '17, *Vice President*

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FUTURE OF GAS TURBINES

(*Concluded from page 568*)

not been sufficiently developed for commercial use. It is presently too sensitive and skittish, too subject to sudden vapors and collapses. But given the kind of facilities represented by laboratories at M.I.T. and others elsewhere, and given the degree of financial support required by the magnitude of the development task, the gas turbine will find its true place of importance in tomorrow's aviation.

AIR TRANSPORTATION

(*Continued from page 526*)

and operate than is now true in the case of the highly developed reciprocating engine.

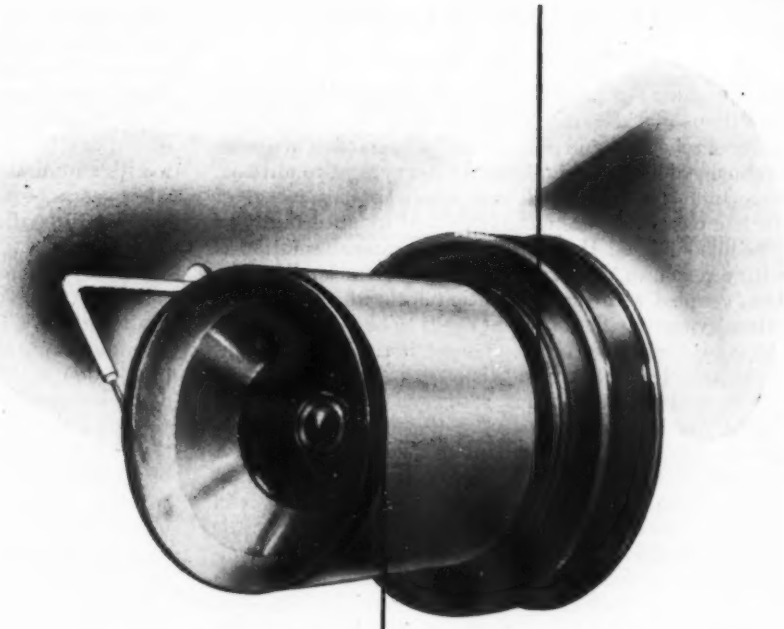
I need not tell you that the British originally developed the turbo-type engine. Several of their manufacturers are in the midst of big turbo development programs, backed by their government. They have a balanced and comprehensive plan for the design of turbo-engined air liners — not only on paper but in process. The engineers of the principal British air line are already thinking readily in terms of operating technique for jet-propelled commercial aircraft. I believe the British are capable of putting jet air liners into regular service within five years. No such program, for commercial aircraft, exists in this country today, although there is good raw material in the form of military jet development. We must remedy the deficiency without delay, and the first step is to see that our air lines are in sufficiently sound financial condition to permit them to place the necessary orders with domestic aircraft manufacturers. Two years from now will be too late.

Airports and Airways

As any motorist knows, there is no use building a bridge unless its approaches can handle the traffic. The airplane is no different. Regardless of its efficiency, the air liner cannot serve the mass market unless there are aids on the ground which will not only guide it accurately from point to point but will also assure the safe and orderly flow which we see in the block system on a railroad. Generally speaking, the machinery for the block system of the air is technically within reach. Less clear is agreement on how to pay for it. Some groups urge that the cost be absorbed directly by the air lines. This is beyond the financial capacity of the air lines. As distinct from the rails, the Federal airways are not used exclusively by the scheduled air lines. A highly developed domestic airways system is vital to the armed forces. From the broad viewpoint, the only possible conclusion is that airways development must be pursued aggressively by the Federal Government. In the future consideration can be given to the possibility of assessing charges to the users.

The topic of airways properly includes mention of facilities for operating under adverse weather conditions. There is no real problem in the all-weather operation of a single airplane; an M.I.T. alumnus, James H. Doolittle, '24, proved that almost 20 years ago. Certain special military transport operations have reaffirmed the fact in recent months. The actual problem is that of handling

(*Continued on page 572*)



THEY CALLED IT "*Revolution in Rayon*"

For years, rayon technologists knew that their traditional processing methods of handling the spun thread in package form resulted in irregularities in viscose yarn. But all their efforts to completely eliminate the undesirable results proved fruitless—until the answer was found at Industrial Rayon Corporation by a group of chemists and engineers headed by a resourceful M.I.T. Alumnus.

Dismissing all traditional views, these men conceived, labored over, and developed what Fortune Magazine, in the issue of September 1946, called a "Revolution in Rayon."

Their ideas resulted in a method whereby each rayon thread was treated continuously throughout each step of the manufacturing process. Each of the separate package operations of the conventional systems—viscose spinning, washing, desulphuring, bleaching, treating, drying, and twisting—were combined into one continuous thread processing operation.

Not only did this Continuous Process Machine result in greater efficiency, superior rayon quality, and higher rayon uniformity, but it cut the manufacturing time from around six days to a few hours.

The Continuous Process is only one of Industrial Rayon Corporation's distinguished contributions to the synthetic fiber industry.

These accomplishments have not only pushed forward the frontiers of rayon technology but have also advanced the chemical and engineering techniques of related industries. The new Continuous Process has been adopted by rayon producers the world over through purchase of patent rights.

Industrial Rayon Corporation invites Chemists and Engineers, who may be interested in becoming associated with its expanding organization, to submit their inquiries and resumés.

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Makers of *SPUN-LO Rayon yarn and cloth • *TYRON Rayon yarn, cord and fabric

*Reg. U. S. Pat. Off.

AIR TRANSPORTATION

(*Continued from page 570*)

large numbers of passenger schedules under instrument conditions at the same rate as in clear weather. Regularity of schedules and punctuality of operations are basic problems of air line operations. Under present conditions, from time to time a small but significant percentage of air line passengers are inconvenienced by uncertainty of scheduled flights. Here again, the technical solution is within reach, in the form of the instrument landing system, coupled with the automatic pilot, radar, and high-intensity runway lights. What needs to be done is to buy the equipment, pay for it, and get it running. Government agencies must see to this.

The final problem in this category is that of airports. While you have all experienced the discomfort of outgrown, inadequate, badly kept municipal air terminals throughout the country, you may not have realized that much of the poor service attributed to the air lines in 1946 was due directly to these very circumstances on the ground. World War II had prevented the cities from undertaking new construction to accommodate the vast new volume of air traffic. Many of the municipalities concerned had not yet been convinced that it was to their own best interest to invest the money, even against self-liquidating leases from air lines and airport concessionaires. The position of the air lines is that a public airport is comparable to other public works, such as streets, bridges, and harbor improvements, which bring commerce, population, payrolls, and taxing power to the municipality, and, that an aggressively managed airport can develop the major portion of its needed revenues from sources other than the air lines. The air lines expect to carry a fair share of the cost, but they cannot carry the whole burden. Fortunately, these problems are being solved one by one, as we can see here, in the Commonwealth's admirable development of Logan Airport. Within a few years the air traveler will see a vast improvement in airports throughout the country.

Safety

The matter of air line safety is important, but can be dealt with in a few words. Safety is relative. I know of nothing which is absolutely safe. Certainly two of our most common occupations, riding in automobiles and doing housework, are relatively unsafe. Riding on scheduled air lines today is very safe compared to most occupations. It can and will be made much safer. The provision of adequate airports and airways, to which I have previously referred, will remove many of the underlying factors in the air-line accidents of recent years. I believe that the accident rate will drop virtually to nil within the next five to ten years.

International Relations

In the international aspect of air transportation we see in sharpest focus both the opportunities and the problems of commercial air transportation.

It is axiomatic that the United States occupies a position of vast responsibility and power in the world today.

(*Concluded on page 574*)

The

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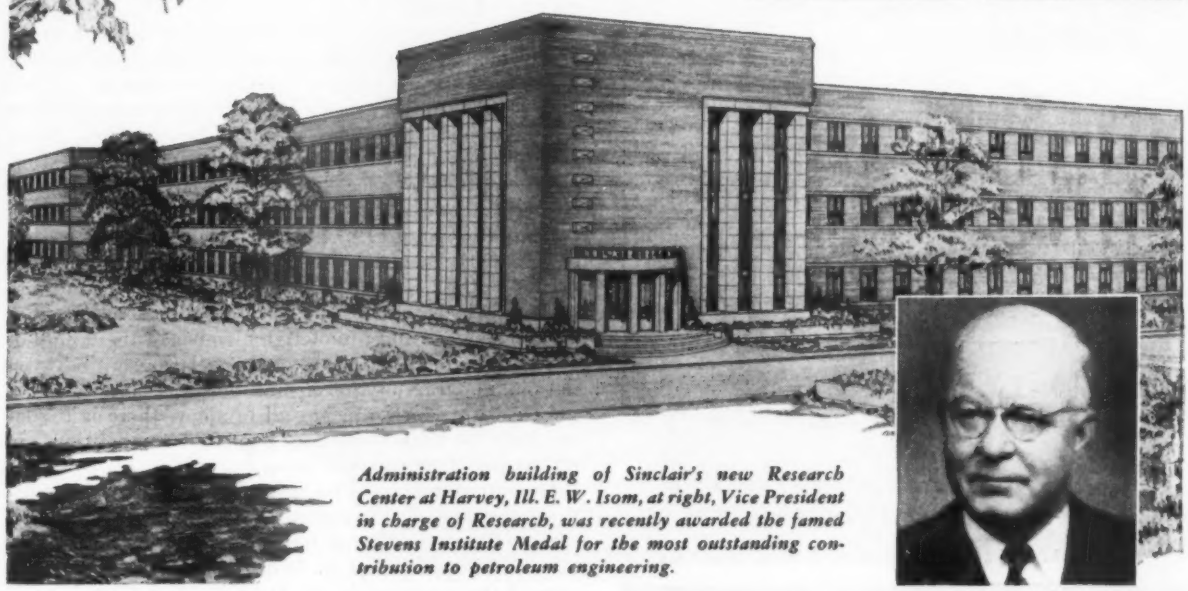

Administration building of Sinclair's new Research Center at Harvey, Ill. E. W. Isom, at right, Vice President in charge of Research, was recently awarded the famed Stevens Institute Medal for the most outstanding contribution to petroleum engineering.

Sinclair is completing a new $4,000,000 petroleum research and development laboratory at Harvey, Ill. This great research center — to be the most modern and best equipped in the industry — climaxes more than 30 years of consistent achievement in the development of superior products for the solution of your most difficult lubrication problems.

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JAMES R. GEDDES '25, *President*

AIR TRANSPORTATION

(Concluded from page 572)

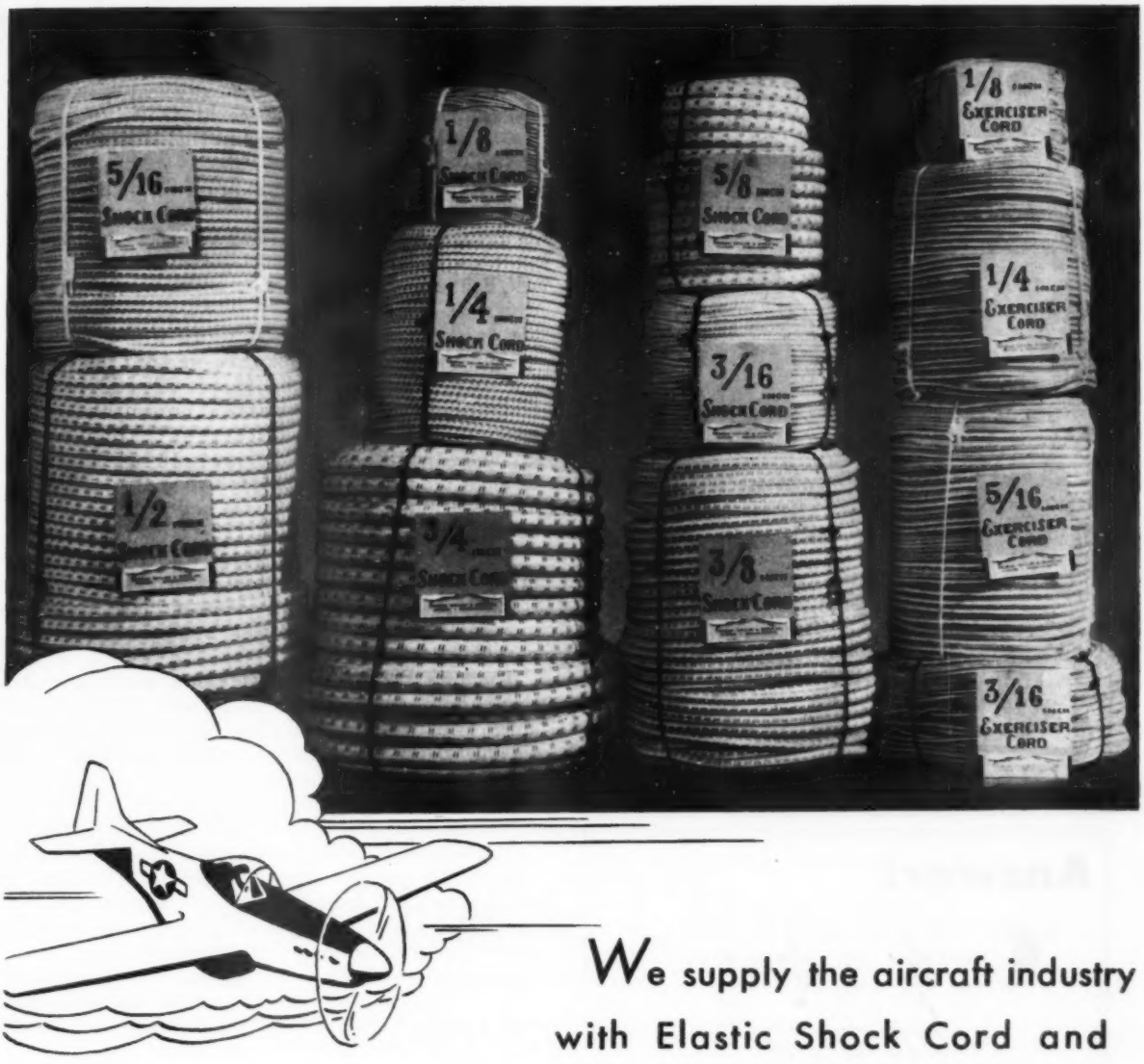
We are going to have to grow rapidly in our appreciation of what this means. Where international affairs are concerned, we in this country are somewhat prone to indulge in wishful thinking. While our ideals of freedom, fair play, and the dignity of man are the priceless catalyst for our actions, we live in a real world of real people. Leadership in a world of sovereign nations requires the sophisticated exercise of power.

The reason one may speak bluntly of power in a world of sovereign nations is simple, but not always perceived. Within any democratic nation there is common acceptance of the orderly process of law. It is not necessary for anything more than police power to be exercised. As between nations, on the other hand, there is not this common acceptance of a legal system whereby the rights of all individuals and groups are reconciled. Adjustments between nations must be achieved by negotiation, leadership, and the beneficent use of strength. It is therefore necessary that each nation seek to remain strong in those respects which are most necessary for its functioning as an independent and productive member of the family of nations. To put the nature of this relationship between nations in terms of the air-line business, and to use a phrase with which you are all familiar, there is fundamentally no such thing as "regulated competition" in international air transportation.

Our international air-line system is a tangible expression to common people throughout the world of America. It is vital to the conduct of our foreign trade and to the support of our diplomatic missions. It does not stop at the boundaries of the oceans as do our American flag steamships. It is seen and its influence is felt by people throughout the world, frequently in remote locations. Indeed, citizens of foreign countries who have never seen a train or steamship are regularly employed to work on air liners carrying the flag of the United States. The skill, efficiency and integrity with which the business of our international air-line system is conducted, and not least of all the personal conduct of our flight crews, have a profound effect on American prestige abroad.

It is plain that the first aim of our air-line system abroad should be that of peaceful commerce. No one here would doubt that the best way to operate this system is with private capital, under private management, with profit as a legitimate motive, and with the public utility concept of public convenience as the principal criterion.

The thought I wish to leave with you is that a strong international air-transport system, flying the American flag, is an absolute essential to the part which we have to play in the world. In my opinion, the proper exercise of power requires the avoidance, and not the attainment, of domination; the desirability of other peace-loving nations participating equitably in international air commerce cannot be doubted. On the other hand, the United States cannot afford to lose its position of leadership on the air routes of the world as we did on the high seas after the era of the sailing clippers. We must, therefore, bring into fine co-ordination the elements of science, engineering, economics, and diplomacy which, taken together, are the essence of success in air transportation — today and tomorrow.



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Answer:

"Candy is dandy —but try a Barbasol face"

Edwin M. McNally, '18
Leon P. Brezinski, '29
Richard L. Berry, '30
John Demo, '35

- No brush
- No lather
- No rub-in

RESEARCH FOR NATIONAL DEFENSE

(*Continued from page 524*)

We need lighter, tougher, and more heat-resisting metals. Suppose that our pistons could stand a temperature rise of a few hundred degrees to enable us to utilize 50 per cent of the power in our aviation engine fuel instead of about half that amount as at present. Our B-29 bomber would then go twice as far as it does now or could achieve its present range with a saving in fuel weight alone, of more than nine tons. In the structure of the airplane itself, lighter and tougher metals will save us much weight which can be put into more fuel, more bombs, more people, or more freight.

With greatly increased speeds, we need much higher rates of fire and much higher muzzle velocities in our aircraft machine guns than we have at present. Before those increases can be made we must have metals that will stand up under the terrific heats generated by pushing bullets through the machine gun barrels at the rates we want. The development of our ordnance is already far behind the development of our aircraft.

We need metals of better conductivity to save weight in our electric wiring systems and our generators. When we realize that the wiring in the modern airplane is measured in miles, it is easy to see that a substantial saving is possible in this field alone.

There are thousands of such examples of the application of lighter and tougher metals which are more resistant to heat. Whether such alloys can be made, or whether we must depend on ceramics for heat resistance, I don't know. That is your problem.

Better Radar Needed

The miracle of radar and its possibilities is continually opening our eyes, but we must utilize it still more and get rid of some of its present limitations. Radar units need to be smaller, lighter, have a much greater range and vastly improved definition. At present, the early detection of an airplane approaching at low altitude is impossible. We need to cure that situation. We want to watch the whole world and see what it is doing. If our ground stations can't see far enough, we will have to carry our radar eyes on patrolling aircraft. The speeds of tomorrow's aircraft will make our present warning service not only obsolete but useless. When every nation can see day and night what the rest of the world is doing, it may be impracticable to plan on a war and we may have peace. However, just to counter too many hopes along that line, we need a camouflage against radar. We need to be able to pick up the approach of enemy aircraft but we also need protection against having our aircraft detected. We want to know what our enemy is doing, but surprise is still a powerful ally to have on our side.

Our airdromes are getting too big and it takes the engineers too long to build them for us. We need devices to launch and land aircraft in shorter distances. We need faster means of making an airdrome and we must be able to utilize for landing and take-off any reasonably level piece of ground that is fairly dry without first compacting it and then covering it with concrete or a steel mat.

Our radio equipment is still too big, too heavy and not sufficiently reliable. Its tuning is not sufficiently stable for military purposes and static still knocks it out. The fre-

(*Continued on page 578*)

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RESEARCH FOR NATIONAL DEFENSE

(*Continued from page 576*)

quency bands are so crowded now that it is often difficult to get a message through over any distance. Improved circuit design will help immensely but progress along this line is disappointingly slow.

The big hazard of flying today is from fire. In peacetime, the crash too often results in the loss of the entire crew and passengers by fire. Our military aircraft cover their fuel tanks with rubber to keep enemy bullets from setting the tanks on fire in air combat. While of inestimable value in air combat, this covering does not help much in a crash and the weight is a serious penalty. In a B-29, for example, the bullet-proof covering of its fuel tanks weighs more than six tons.

Subtracting Fuel from the Fire

We need a fuel that does not burn except in the engine and which has some of the characteristics of coal. It burns only in the stove. No one ever heard of the coal in a coal truck catching fire just because the driver ran into a tree or a telephone pole. It is even possible to shoot a bullet through a bomb without detonating the T.N.T. and releasing the power contained in it. We desperately need an aircraft engine fuel — solid or liquid — that does not constitute the combat and crash fire hazard that we must now tolerate.

We need better and more efficient fuels with more energy per pound for reciprocating engines, jet engines, and for rockets. There must be room for still more progress along these lines in spite of the tremendous advances made in the last 20 years.

We hear a lot of talk about engines driven by atomic energy. There is some work being done along that line now but I wonder if we are moving fast enough to insure that someone else does not outstrip us in the race. If we are second in this race, we should realize that, in a future conflict, it is going to be a case of "the winner takes all."

The long-range radio controlled missile of tomorrow must be countered. Not only must we be able to detect the fact that it is on the way but we need quickly to find the frequencies on which it is being operated and then cut in with our own radio control and prevent it from reaching us — the target. We may have to intercept it with a type of target-seeking antiaircraft guided missile of our own.

We need an automatic position finder giving our guided missiles a continuous position fix, and hooked into the controls so that the explosive charge will be detonated at the exact latitude and longitude of the target. The lack of accuracy at long ranges today makes it impractical even to approach precision bombing unless the bombardier can actually see the target and direct the bombing from his own airplane or from a mother ship for one or more "drones."

Aircraft speeds are about to pierce the so-called sonic barrier. Actually, we know about as much about this new field as the Wright Brothers knew about what they were getting into in 1903 just before they took off on that

(*Continued on page 580*)

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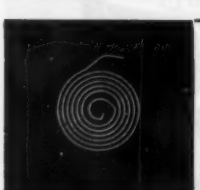

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RESEARCH FOR NATIONAL DEFENSE

(*Continued from page 578*)

December morning down at Kitty Hawk, N. C. We need a great deal of research on airfoil sections and fuselage shapes which are to fly at velocities greater than the speed of sound. What happens to our aircraft controls at these speeds? Can we trust the human being to operate controls manually and hope that the pilot will not black out every time he touches them? Where are our instruments for the supersonic airplanes? What will happen if you shoot a gun out of an airplane traveling at, let us say, 2,000 miles an hour? Can you open bomb bay doors and drop bombs from a bomber traveling at that speed? The list of questions is endless but the answers are still to be worked out.

What about the use of sound as a weapon? I refer to sounds that are not perceived as such by the human ear but which may have a serious effect on the human system. The familiar dog whistle may give us an example. This sound, inaudible to humans, is heard by the dog but it does not make him happy. His reaction is a nervous one; he is startled into attention. It may be just another newspaper story, but I read the other day of a man who is now being checked over by the British medical people after working in a laboratory testing new jet engines. The story was that his nervous system was out of gear from exposure to sound waves above the range of audibility of the human ear. Conceivably, an airplane equipped with a sort of super dog whistle could fly around a city long enough to upset the nervous systems of the entire population. I believe we need to do some research along this line which may represent just a fantastic dream. It may not.

Light waves offer a similar field. By utilizing wavelengths above the infrared and below the ultraviolet there may be the possibility of developing weapons of future warfare as devastating as the atomic bomb. Other nations may develop them. We must keep pace in order to be able to counter or defend against such threats.

Doing Something About Weather

Weather is a field of research that offers tremendous possibilities. On a limited scale we can already break up clouds and start rainfall where and when we want it. Instead of allowing rain clouds to drive past arid and semi-arid sections, we should be able to shoot them down and put the rain where we need it. If we can extend this process we can stop rain from falling where it has been falling for ages. It is not inconceivable that the nation that first learns to plot the paths of air masses accurately, and learns to control the time and place of precipitation,

(*Concluded on page 582*)

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RESEARCH FOR NATIONAL DEFENSE

(*Concluded from page 580*)

will dominate the globe. The change of a few inches of rainfall a year in many parts of the world would mean the difference between normal crops and starvation. We must not fall behind in this line of research.

While I have covered numerous points that may seem to imply that our brains should be harnessed to the problem of how to obliterate the whole human race, you will note that practically every one of them can be utilized to benefit humanity and give us a greater civilization. If man is determined to exterminate himself, he probably will succeed. If he tries hard enough, he may even turn this globe of ours into a cinder some day.

If the weapons of warfare become too terrible, that fact may drive some sense into the brain of what we are pleased to call *Homo sapiens* and induce him to find a way of settling his disputes without exterminating his opponent. Gas warfare has not been used since 1918 primarily because it was too easy for both sides to use it and neither combatant dared to risk retaliation in kind. Perhaps when every nation possesses all the diabolical weapons that can be devised they will be afraid to start the slaughter. There is no profit in winning a war if, in the process, you also are destroyed. If the world ever wakes up to the fact that in modern warfare both sides lose, we may have peace.

In the meantime we cannot diminish research. The laboratories of the world are burning the midnight oil these days searching for newer and more deadly weapons. If we fall behind in this race, we will some day find ourselves defenseless. If we neglect our defenses and are unable to protect ourselves and the ideals and principles for which we stand, those ideals and principles will perish and we shall perish with them.

In the councils of nations, the strong are listened to; the weak are ignored. Weakness will not give us peace. It will invite the Four Horsemen — War, Pestilence, Famine, and Death.

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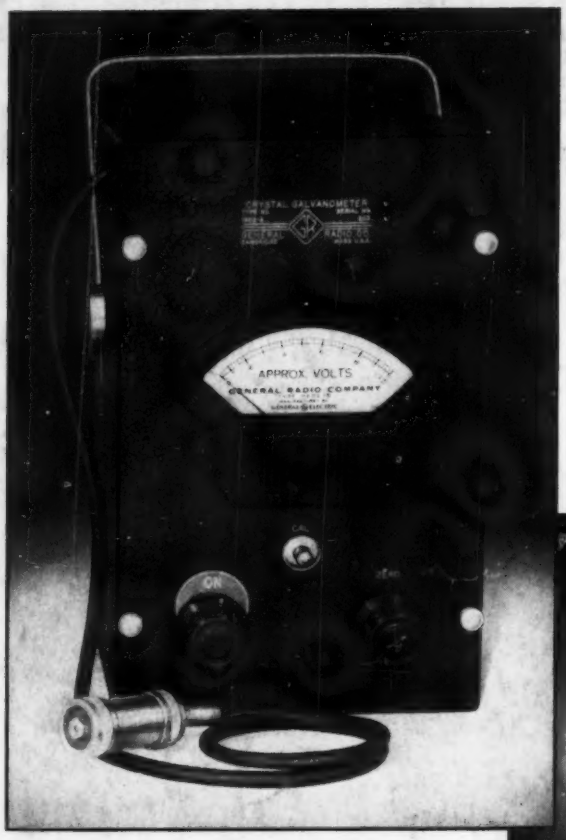

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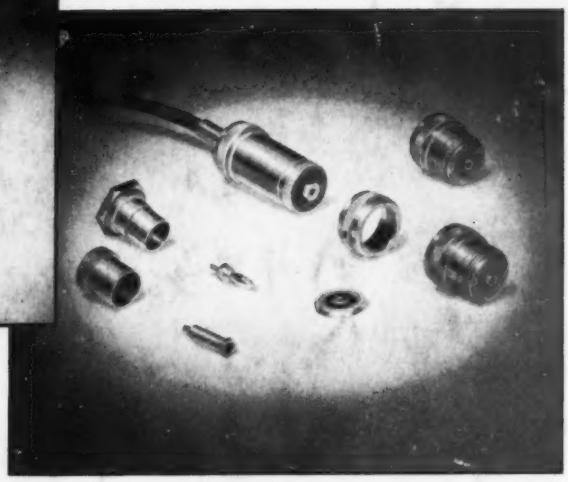

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